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OU3 IDENTIFICATION AND INITIAL SCREENING OF CANDIDATE TECHNOLOGIES

Shieldalloy Metallurgical Corporation Superfund Site

Newfield, Gloucester County and Vineland, Cumberland County, New Jersey

Prepared for

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ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Contaminant of Concern
CPS	calcium polysulfide
DSRA	Development and Screening of Response Alternatives
EVO	Emulsified Vegetable Oil
ft bgs	feet below ground surface
GAC	granular activated carbon
gpm	gallons per minute
GRA	General Response Action
GWQS	New Jersey Ground Water Quality Standard
HHRA	Human Health Based Risk Assessment
IHAL	Interim Health Advisory Level
IISCT	Identification and Initial Screening of Candidate Technologies
MNA	Monitored Natural Attenuation
NJDEP	New Jersey Department of Environmental Protection
OU	Operable Unit
ppb	parts per billion
RSL	Regional Screening Level
SLERA	Screening-Level Ecological Risk Assessment
SMC	Shieldalloy Metallurgical Corporation
TCE	trichloroethene
TRC	TRC Environmental Corporation
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

On behalf of Shieldalloy Metallurgical Corporation (SMC), Geosyntec Consultants, Inc. has prepared this Identification and Initial Screening of Candidate Technologies (IISCT) to address Operable Unit (OU) 3 Perchlorates at the Shieldalloy Corporation Superfund Site in Newfield, New Jersey. OU3 is defined by USEPA as perchlorate contamination in soil, groundwater, and surface water and sediment in Site-associated bodies of water. This IISCT was prepared in accordance with USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

1.1 Scope

Attachment A includes previously collected data that shows that perchlorate concentrations in Site soil, surface water and sediment are below respective USEPA Residential Regional Screening Levels (RSLs). Consequently, the IISCT report focuses on identifying candidate technologies to treat perchlorate contamination of groundwater. Though the perchlorate plume was well-defined at that time, more current groundwater sampling is needed to assess whether conditions have changed. A workplan for groundwater sampling is being developed concurrently with the IISCT and this work is expected to be carried out by the end of 2019.

The aim of this IISCT is to:

- Compare General Response Actions (GRAs) and process options in terms of criteria referenced in USEPA guidance (relative implementability, effectiveness, and cost). This is mainly to ensure that no potential processes are overlooked;
- Perform a second evaluation of GRAs and process options that considers Site history, layout, past environmental investigations, and exposure settings; and
- Allow later Feasibility Study-related deliverables, specifically the Development and Screening of Response Alternatives (DSRA), to build upon these evaluations and utilize up-to-date information (i.e. current concentrations of perchlorate, beneficial impacts from OU1 and OU2 remediation) to combine the most impactful technologies into appropriate remedial alternatives.

1.2 Site Location and History

The Site is comprised of 67.7 acres previously devoted to manufacturing (Main Facility) and 19.8 acres of farmland (Farm Parcel) located about 2,000 feet apart. The Site is mainly located in Newfield, Gloucester County, New Jersey, though portions fall within Vineland, Cumberland County, New Jersey municipal bounds. The Site address is 35 South West Boulevard, Newfield. Figure 1 shows the Site location.

Specialty glass manufacturing began at the Main Facility in 1924. SMC purchased the facility in the early 1950s and, from 1955 to approximately 2007, manufactured items such as specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals and optical surfacing products. Current and historical use of the Farm Parcel remains agricultural.

According to information provided by SMC staff generally familiar with past operational practices, potassium perchlorate was used as an oxidizer in the on-Site furnace to increase temperature and enhance furnace performance. The furnace was located within the footprint of former Building D102(A), attached to but isolated from Building D112. Both buildings have since been demolished. Building D102(A) was characterized by an earthen floor (although the area surrounding the building is currently and was historically paved). According to historical purchase order records, SMC purchased approximately 400,000 pounds of potassium perchlorate from 1974 to 1992 for this operational activity. Potassium perchlorate was typically packaged and shipped to the Site in 110-, 250-, and 350-pound, plastic-lined steel drums. Prior to being used in the furnace, this product was reportedly stored on Site in a former small metal outbuilding (referred to as the Former Chemical Storage Building), east of former Building D102(A) and near the unpaved road forming the northwest boundary of the storage yard slag piles. This Former Chemical Storage Building was characterized by a concrete interior floor and berm around the building's perimeter. Based on this reported information, the storage and usage of perchlorate on Site were limited to these areas, which are identified in Figure 2. Since perchlorate was completely destroyed in the heating process by reacting with aluminum to form chlorides, there was no general release from this process. Only incidentally spilled material or small amounts of incompletely reacted material would potentially be released into the environment. One possible disposition for incompletely reacted/residual perchlorate was release to a former lagoon area, also shown in Figure 2 (TRC September 2016).

1.3 Environmental Investigations and Remediation

Environmental investigations at SMC began in 1972 to determine whether there was a relationship between the Site's operations and elevated concentrations of metals in the municipal water supply. Consequently, the Site has an extensive history of soil, groundwater, sediment and surface water investigation. Remedial activities that are possibly relevant to perchlorate investigation and remediation are summarized below (TRC October 2008; USEPA September 2015):

- SMC installed an 80 gallons per minute (gpm) groundwater pump and treat system in 1979 to remediate chromium and trichloroethene. The groundwater was treated using ion exchange.
- SMC installed additional wells and increased extraction to 400 gpm to control off-Site migration of hexavalent chromium in 1988 and 1989.
- SMC expanded the treatment system to include an air stripper to address trichloroethene (TCE), a second Contaminant of Concern (COC).
- SMC switched from ion exchange to electrochemical precipitation in 1991 to address chromium concentrations in the extracted groundwater.
- SMC characterized, treated and closed nine wastewater treatment lagoons from 1994 to 1997.
- Investigation of plume geometry of various COCs through vertical profiling and monitoring well installation is completed from 2002 to 2011.

- In situ remediation treatability studies began in 2010 after finding the current treatment systems were no longer efficiently treating Site COCs (concentration reduction had become asymptotic). Calcium polysulfide (CPS) was identified as an effective reagent for treating chromium-impacted groundwater. Emulsified Vegetable Oil (EVO) was found to be an effective electron donor to promote microbial degradation of TCE.
- SMC installed a new ion exchange unit in the groundwater treatment plant in 2011.
- TRC conducted an Ecological Risk Assessment and a Human Health Risk Assessment (HHRA) for OU3 in 2013 and 2014, respectively.

Perchlorate impacts were initially assessed during monitoring events in 2004. Concentrations in soil, surface water and sediment were reported to be below respective USEPA Residential RSLs. Therefore, these media were not further evaluated. Perchlorate concentrations in groundwater were detected above the New Jersey Class II-A Ground Water Quality Standard (GWQS) of 5 parts per billion (ppb) (TRC October 2014; NJDEP August 2018). Data obtained for all media are included in Attachment A to this document. Periodic groundwater sampling was conducted until 2011, when the perchlorate plume was sufficiently defined to the USEPA Interim Health Advisory Level (IHAL) of 15 ppb. Isopleths developed from the 2011 data are provided in Attachment B and show perchlorate present at concentrations above the GWQS in the shallow, intermediate and deep aquifer zones, with the plume deepening and migrating in a southwesterly direction under the influence of advective groundwater transport and a downward hydraulic gradient (TRC June 2011; TRC Sept 2016).

1.4 Perchlorate in the Regional Environment

Moderate perchlorate concentrations in the deep aquifer zone in wells that are located upgradient of the Site's potential perchlorate source areas suggest that there may be a regional perchlorate contamination issue unrelated to Site activities (data provided in Attachment A). The regional presence of perchlorate may have resulted from the extensive agricultural land use within the area and the potential use of Chilean-mined fertilizers (of which perchlorate is a component) on the cultivated soils of the area farms. The documentation of the presence of perchlorate in lettuce crops in Newfield and Bridgeton and spinach crops in Vineland (U.S. Food and Drug Administration, 2005) and the historical use of irrigation wells in the area provide additional evidence of a regional groundwater perchlorate issue. In 2009, drinking water quality testing conducted by the City of Vineland (which obtains its drinking water from groundwater) included perchlorate as an analyte under the Unregulated Contaminant Monitoring Rule (City of Vineland, 2009). Perchlorate was reported at concentrations ranging from 5.18 to 6 ppb in drinking water supply samples, further demonstrating the regional presence of perchlorate in the groundwater (TRC Sept 2016).

1.5 Site Geologic, Hydrogeologic, and Hydrologic Setting

1.5.1 Geology

Three unconsolidated sedimentary units underlie the Site. From shallowest to deepest they are:

- The Bridgeton Formation- consists of up to 28 feet of brown sand present on most of the Site;
- The Cohansey Sand- comprised of coarse sands and little silt in the upper 40 feet, with generally finer sand and some clay and silt lenses in the lower 60 to 80 feet. Discontinuous silt and clay up to 6 feet in thickness is found within the lower section of the formation. The Cohansey Sand is predominantly composed of quartz, and secondary minerals include aluminum oxides and iron-containing minerals (e.g. illite and pyrite) (TRC March 2015); and
- The Kirkwood Formation- consists of a gray silt and clay layer, and is generally encountered between 121 and 153 feet below ground surface (ft bgs).

Bedrock has not been encountered in previous Site investigations; it is estimated that the depth to bedrock beneath the Site is approximately 2,000 ft bgs (TRC September 2016).

1.5.2 Hydrogeology

The principal aquifer at the Site and surrounding area is the Cohansey Sand aquifer, which is approximately 130 feet thick. The upper portion of the Kirkwood Formation, consisting of silt and clay, functions as a confining unit by restricting the downward flow of groundwater. Groundwater flow direction in both the upper and lower Cohansey sand is southwest toward an on-Site stream known as the Hudson Branch. Seasonal fluctuations in water table elevations are on the order of a few feet, and depth to groundwater has been measured at 4 to 27 ft bgs (TRC September 2016; TRC March 2014).

1.6 Exposure Setting and Determination of Remedial Objectives

In 2014, a HHRA was conducted for OU3. The assessment rules out soil, surface water and sediment as posing a risk to human health. It reported that the following receptors were at risk of unacceptable perchlorate exposure through ingestion of groundwater, according to USEPA guidance:

- Future child resident exposed to on-Site shallow groundwater;
- Future adult and child resident exposed to off-Site deep groundwater;
- Future child resident exposed to Farm Parcel intermediate groundwater; and
- Future adult and child resident exposed to Farm Parcel deep groundwater.

Since the time the HHRA was completed, New Jersey has adopted a GWQS for perchlorate of 5 ppb for Class II-A groundwater. Class II-A groundwater is defined as groundwater that can be used as potable water or converted to potable water through treatment, mixing or other similar technique (NJDEP August 2018). Considering the institutional restrictions adopted for the Site (described further in Section 2.2), the fact that the only at-risk receptors are residents ingesting groundwater, and the fact that the GWQS was developed assuming the possibility of potable groundwater use, a remedial objective of 5 ppb will protect human receptors from unacceptable risk (TRC October 2014).

Additionally, a Screening-Level Ecological Risk Assessment (SLERA) was conducted in 2013. In accordance with USEPA guidance, the study utilized the maximum concentrations of perchlorate detected in Site soil, groundwater, surface water and sediment to conservatively calculate the concentration of perchlorate that various communities of living organisms might be exposed to, as well as the maximum daily dose that might be consumed by multiple indicator species. The study concluded that even the highest perchlorate concentrations measured on Site are unlikely to pose a risk to terrestrial or aquatic communities (TRC May 2013).

2. IDENTIFICATION AND EVALUATION OF GENERAL RESPONSE ACTIONS

According to USEPA guidance, there are three phases of the Feasibility Study process: the development, screening, and detailed analysis of remedial alternatives. This IISCT begins to address the first two phases, which can be further broken down into the following steps:

- Define remedial action objectives;
- Identify and develop GRAs that may allow the remedial action objectives to be achieved;
- Identify the areas of media that to which the GRAs may be applied;
- Identify and screen all technologies applicable to each GRA and eliminate those that cannot be implemented at the Site;
- Identify and evaluate process options that can be used to employ the various technologies; and
- Assemble the selected process options into alternatives that may effectively achieve remedial action objectives.

The guidance allows for these steps to be revisited multiple times (USEPA October 1988). As discussed, this IISCT will begin to evaluate the applicability of several GRAs (listed below) using data which are predominantly from 2011. The assessment will be updated with the 2019 groundwater data are available.

1. No Action
2. Institutional Controls
3. Monitored Natural Attenuation (MNA)
4. Collection/Hydraulic Containment
5. Collection/Containment Enhancements
6. Ex Situ Treatment
7. In Situ Treatment

2.1 No Action

The No Action GRA is used as a baseline with which to compare other remedial alternatives. As stated previously, the most recent groundwater data indicates that perchlorate is above GWQS, so current data are required before determining whether No Action may be appropriate for OU3 (USEPA October 1988). Following collection of 2019 groundwater data, the No Action GRA will be revisited in the DSRA.

2.2 Institutional Controls

NJDEP classifies the groundwater on Site and the evaluated groundwater off Site as Class II-A. Institutional Controls (ICs) such as well restrictions may be used to prevent groundwater use that may be harmful to human health or the environment but otherwise accepted under the Class II-A standard. Though unlikely to act as a stand-alone remedial alternative, such controls can be an important part of a viable alternative. ICs in place at SMC include:

- As of 2016, the City of Vineland had designated an area downgradient of SMC as a well restriction area requiring mandatory connection to the public water systems (TRC September 2016);
- According to a 2017 draft OU2 Final Design Report by TRC, a Site-wide Classification Exception Area (CEA) was issued as part of the OU1 remedial activities. The CEA will provide notice of groundwater contamination and, therefore, the need to limit human activities at or near a contaminated Site in order to ensure the effectiveness of remedial actions over time; and
- A deed notice has been issued as part of the OU2 remedial activities, which restricts future Site use to non-residential activities (TRC March 2017).

Following collection of 2019 groundwater data, the need for and scope of potential ICs will be revisited in the DSRA.

2.3 Monitored Natural Attenuation

Perchlorate can naturally attenuate through a variety of biological and physical processes, including biodegradation under appropriate groundwater geochemical conditions, and physical dispersion and dilution. If these processes are occurring to a sufficient extent that they control plume migration and can cause the plume to shrink over time, then MNA may be a viable stand-alone groundwater remedy, or MNA may be a component of a remedy that involves other more active components, such as enhanced in situ bioremediation. MNA is often used in conjunction with source remediation or control and ICs.

Long-term monitoring of OU3 may not significantly affect SMC's costs or efforts since MNA is part of the alternative chosen for OU1, and many OU1-associated wells may fit in with an OU3 monitoring network (USEPA September 2015). Attachment B shows recent depictions from TRC of the perchlorate, chromium and TCE plumes in order to provide a visual of this OU1 and OU3 overlap.

Groundwater data collected in 2019 will be compared against past perchlorate data to assess the nature and extent of any perchlorate attenuation, and to assess the potential role of MNA as a stand-alone or component of a groundwater remedy. MNA will be revisited in the DSRA.

2.4 Collection/Containment

Groundwater collection/containment is a commonly used remediation approach for perchlorate plumes. In these cases, groundwater is typically extracted using conventional vertical extraction wells or in some cases horizontal wells, conveyed back to an ex situ treatment facility where the perchlorate is removed (see Section 2.5), and the treated water is then either surface discharged or recharged to the aquifers under appropriate permits. In some cases, the treated water is used for beneficial purposes, such as irrigation or as drinking water.

While groundwater collection and containment can be an effective remedial technique for perchlorate plumes, it is often viewed as undesirable, since it doesn't address source materials, but rather is a long-term costly method of preventing continued migration. In addition, since much of the plume is present on land not owned by SMC, there would be complications with siting extraction wells and conveyance piping a centralized treatment plant(s). Collection/containment will be retained as a GRA for evaluation in the DSRA, in the event that the 2019 data indicate that no better options exist to address the perchlorate plume.

2.5 Collection Enhancements

Low permeability of Site geology is generally the main motivation for using collection enhancement technologies. Former investigations note that the Site consists of mainly sand until at least 121 ft bgs. Therefore, it is unlikely technologies such as pneumatic or hydraulic fracturing would significantly improve an extraction system on Site. Additionally, a major drawback of fracturing techniques is unintentional creation of channels that might allow a COC to spread. Because the overall Site is affected by COCs other than perchlorate, there is reasonable concern that fracturing or permeability enhancements to promote perchlorate collection could adversely affect containment of OU1 COCs. However, if collection is used to treat OU3 and proves difficult, extraction enhancements such as flushing the target zone with water may be less intrusive than permeability enhancements.

2.6 *Ex situ* Treatment

Several ex situ treatment methods have been used at the Site to treat COCs other than perchlorate. Extracted groundwater has been treated with ion exchange units, electrochemical precipitation, and air stripping (USEPA September 2015). The former two methods could effectively reduce perchlorate concentrations if the extraction network is adequately developed to target the perchlorate plume. Filtering with reverse osmosis (RO), reduction in bioreactors, or tailored granular activated carbon (GAC) can also be considered. Bioreactors have the advantage of biodegrading perchlorate to innocuous end products, whereas RO, GAC, and ion exchange physically remove perchlorate and require further handling and/or disposal of the spent ion exchange resin, GAC, or RO rejectate. Engineered wetlands could also be used as a treatment technology for perchlorate in the extracted groundwater. As part of OU2 remediation activities, the Site's natural wetlands will be restored and could be included in an OU3 remedial alternative (TRC March 2017). The OU2 footprint is included in Attachment B for comparison with that of OU3.

Of note, the applicability of each ex situ treatment technology depends on the perchlorate concentration in the extracted groundwater, the geochemistry of the groundwater (e.g., nitrate, iron content, other COCs), and the end fate/use of the treated groundwater (e.g., surface discharge, aquifer recharge). Tailored GAC may be useable for very low perchlorate concentrations (<20 ppb) in extracted groundwater; ion exchange for low to moderate concentrations (20 to 500 ppb), bioreactors for high concentrations (500 – 10,000 ppb), and RO for very high concentrations (>10,000 ppb). Data from the 2019 groundwater sampling will be used to assess what ex situ treatment techniques will be best suited for Site conditions, and this information will be further reported in the DSRA.

2.7 *In situ* Treatment

Perchlorate is known to be readily biodegradable under anaerobic conditions by a wide variety of naturally occurring microorganisms (Waller et al., 2003). As such, in situ bioremediation (ISB) has been widely used as an effective remedial for perchlorate sources and plumes. ISB approaches typically involve the injection of carbon-based electron donors such as lactate, molasses or emulsified vegetable oil (EVO). TRC has previously injected EVO to anaerobically biodegrade TCE using ISB; a similar process could be conducted for perchlorate in groundwater. Data from the 2019 groundwater sampling will be used to assess whether perchlorate is naturally biodegrading in situ, and where enhanced ISB may be beneficial to control migration, reduce perchlorate mass in groundwater, and/or to reduce perchlorate mass flux from the Site. Potential ISB approaches will be further reported in the DSRA.

3. EVALUATION OF PROCESS OPTIONS

The next step in this screening of candidate technologies is identifying and evaluating the various technologies and process options that fall within each GRA. Each of these process options are analyzed in Table 2 through a non-Site-specific lens using criteria referenced in USEPA's 1988 guidance: implementability, cost and effectiveness. Each process option was scored using these concepts using a scale from 1-4 (4 being the best). In accordance with USEPA guidance, the effectiveness category has been expanded to evaluate the following sub categories: long term effectiveness, short term effectiveness, and ability to reduce volume, concentration and/or mobility of perchlorate. These criteria are also defined in detail in Table 2. This non-Site-specific evaluation is expected to aid the remedial selection process, and will be refined with Site-specific details once the 2019 groundwater data are available.

If Site conditions have remained similar to those of 2011, Table 3 will also guide remedial selection as it provides a more Site-specific evaluation of each process option. Characteristics considered include the expected horizontal and vertical extents of the perchlorate plume and the Site's geology and hydrogeology. Table 3 expands on the information provided in Section 2 of this document, and similarly to Table 1, does not eliminate any process options from further evaluation. Perchlorate concentrations detected in upcoming sampling, plus testing for range of geochemical features including pH, oxidative-reduction potential, dissolved oxygen, turbidity, specific conductance, and iron, nitrate and sulfate levels will aid in the alternatives development process, which will be included in the DSRA.

4. SUMMARY

The two analyses discussed in this report and presented in Tables 2 and 3 intend to support future remedy selection for OU3. This comprehensive review of all available technologies for treating perchlorate contamination will be an important tool in developing and presenting effective remedial alternatives in the DSRA.

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TABLES

Table 1
Identification of General Response Actions
Shieldalloy Metallurgical Corporation Superfund Site

General Response Action	Description	Retained or Eliminated	Comments/Justification
No Action	No action. Excludes any future activity such as maintenance, monitoring or establishment of institutional controls.	All GRAs will be retained and reevaluated in the DSRA based on future groundwater sampling results and OU1 and OU2 status	Will be considered after gathering current groundwater data.
Institutional Controls (ICs)	Establishment of institutional controls to serve as notice of remaining impacts to groundwater and to prevent receptor exposure.		Already in place; additional ICs could be necessary to prevent groundwater use before other remedial activities are complete.
Monitored Natural Attenuation	Reliance on natural attenuation processes (such as degradation, dispersion, dilution) to achieve remedial objectives within a predetermined timeframe.		Expected to be a viable response; perchlorate can naturally attenuate depending on geochemical characteristics. These parameters will be measured in 2019 groundwater sampling. The current data will also be compared to past data to assess the extent of attenutation.
Collection/Hydraulic Containment	Construction of physical barriers to isolate impacted groundwater and/or use of pumps to collect and remove impacted groundwater.		Potentially applicable; access challenges may arise if groundwater needs to be extracted from wells that are not on SMC property.
Collection Enhancements	Use of permeability enhancers or vacuum to improve collection of impacted groundwater in terms of radius and volume.		Potentially applicable if perchlorate is present in low permeability materials that limit extraction without enhancement.
Ex-Situ Treatment	Removal and treatment of impacted groundwater, and subsequent return to the aquifer.		Historically, *ex-situ* treatments have shown some success at the site. *Ex-situ* treatments are commonly used to treat perchlorate impacts to groundwater.
In-Situ Treatment	Injection or placement of reagents into groundwater to treat contamination.		Expected to be a viable response; OU1 COCs have been treated via the same reducing mechanisms known to degrade perchlorate.

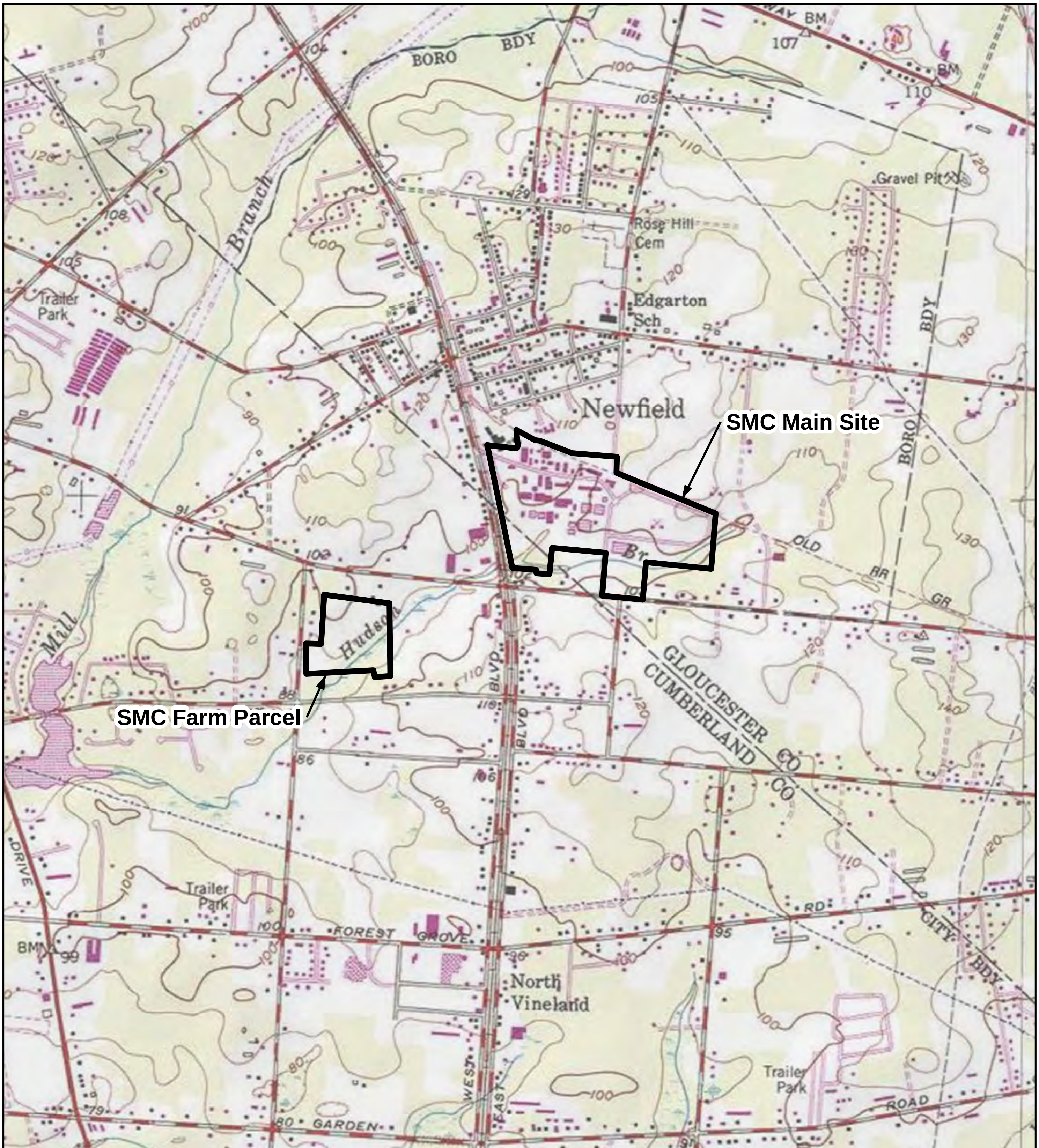
Table 2
Identification and Evaluation of Process Options
Shieldalloy Metallurgical Corporation Superfund Site

			Criteria	Long Term Effectiveness	Short Term Effectiveness	Ability to Reduce Volume, Concentration and/or Mobility of Perchlorate	Cost	Implementability
			Criteria Description	Ability of remedial alternative to continue to protect human health and the environment and comply with regulations after remedial action is complete.	Ability of remedial alternative to protect human health and the environment and comply with regulations during the implementation period.	Estimation of ability to reduce perchlorate impact should ultimately be based on site-specific modeling, bench and pilot studies, and literature reviews.	The main purpose of this criteria is to effectively compare remedial alternatives, rather than estimate cost of individual actions with absolute accuracy. However, applicable cost estimating tools include vendor information, cost curves, prior estimates, site-specific information, and generic unit costs.	Ability to construct, operate, maintain, replace, and ultimately monitor the effects of a remedial action must be considered. Logistical, climate and terrain limitations are also considered.
General Response Action	**Remedial Technology**	**Process Option**	**Description**	**Scoring:** **1- Minimally effective/economical/implementable** **2- Somewhat effective/economical/implementable** **3- Very effective/economical/implementable** **4- Extremely effective/economical/implementable**				
No Action (NA)	No Action	No Action	No action. No further investigation or remedial activities would take place.	1- Does not intend to reduce perchlorate concentrations.			4- Only cost comes from proposing decision to EPA.	4- Requires no onsite work.
Institutional Actions	Monitoring	Groundwater Monitoring	Periodic sampling and analysis of groundwater to monitor and document changes in COC concentrations over time.				4- Low cost due to little labor needed compared to full-scale remediation.	4- Subject only to well access and maintenance.
	Use Restrictions	Institutional Restrictions	Institutional controls will be established to prevent risk to human health or the environment due to groundwater use.	2- Relies on local laws to not be changed, and citizens to abide by and stay aware of all restrictions.	2- Relies on citizens to abide by and stay aware of restrictions.	1- Does not intend to reduce perchlorate concentrations.	4- Low cost; requires little to no on site work.	4- Dependent only on given authority's acceptance of restriction proposal rather than on unpredictable site conditions, research and technical capability.
Monitored Natural Attenuation (MNA)	MNA	MNA	Long-term monitoring of natural attenuation mechanisms, including biotic and abiotic degradation/transformation, dispersion and dilution.	4- MNA is only implemented if it is reasonably expected that concentrations will reach an acceptable level long term.	2- Implementation period is protective of human health and the environment in that only periodic sampling is needed (rather than frequent presence of workers to implement remedial technology), but concentrations may be above regulatory standards in the short term.	4- Perchlorate concentration reduction would be the ultimate goal of MNA.	4- Low cost due to comparatively low labor (only samplers and site modelers needed rather than contractors, long field events etc.)	4- Subject only to well access, maintenance, and understanding of perchlorate fate and transport.
Collection/Containment	Extraction	Extraction Wells	Use of existing and/or installation of additional extraction wells to extract contaminated groundwater and control groundwater migration.	4- If entire volume of contaminated water can be extracted and treated, and wells can be safely abandoned, long term protection of human health and environment is expected.	1- Complete extraction of a plume can take very long periods of time.	4- Extraction and proper treatment of groundwater can reduce perchlorate concentrations.	1- Extraction and treatment are relatively energy intensive. Would also require well and system maintenance and oversight.	2- Extracting and treating large volumes of water can be logistically challenging.
	Containment	Vertical Barrier Walls (VBWs)	Use of VBWs which are composed of native soils enriched with bentonite or another type of clay, and are used to control mass flux and migration of contamination in the subsurface. Other materials such as cement, geomembranes, grout curtains and steel sheet piling can also be used separately or in combination.	1- Wall must be maintained; does not intend to reduce perchlorate concentrations. Perchlorate plume could move below wall.	1- Wall installation may require building and access permits.	2- Reduces mobility of perchlorate but not concentration.	1- Expenses rapidly increase with increasing plume size and depth.	1- Implementability rapidly decreases with increasing plume size and depth.
		Pressure Grouting	Injection of grout to reduce permeability within or below the containment area, and subsequently reduce infiltration and/or transport downgradient.	1- Dependent on grout longevity; does not intend to reduce perchlorate concentrations. Perchlorate plume could move below grouted areas.	2- Possible that less ground must be broken than when installing a vertical barrier wall.			
Collection Enhancements	Extraction Enhancement	Recharge	Injection of water into the subsurface to flush the target zone and enhance mass removal at the extraction well.	3- May allow all contaminated water to be extracted and treated.	2- Could enhance short term effectiveness of extraction system. Permits or testing may be required to discharge water to ground.	3- Could enhance ability to extract and treat contaminated water, could dilute groundwater to safer concentrations.	2- Adds additional costs in terms of design and planning on top of extraction costs.	3- Requires vertical and horizontal precision of water recharge locations.
Ex Situ Treatment	Physical Treatment	Ion Exchange/Adsorption	Use of resins that promote anion exchange for perchlorate removal.	4- Ultimately perchlorate is removed from groundwater and treated or disposed off-site.	2- Extraction of contaminated groundwater can create other exposure pathways.	3- Ultimately perchlorate is removed from groundwater, but is not degraded and must be disposed.	1- Extraction, equipment, maintenance and disposal of extracted perchlorate (resin, GAC or RO brine) can be costly compared to less invasive approaches (MNA, EISB etc.).	3- Technology is well-developed, specifically for perchlorate removal. Relatively more difficult to implement than less site invasive approaches (MNA, EISB etc.). Extraction of large volumes of water may be difficult to manage and dispose.
		Filtration	Use of filtration (tailored granular activated carbon (GAC), biologically active carbon (BAC), reverse osmosis (RO), etc.) to remove perchlorate ions.					
	Biological Treatment	Constructed Treatment Wetlands/ Phytoremediation	Use of engineered wetland to biodegrade perchlorate in wetland sediments.	2- Generates less harmful waste compared to other *ex situ* treatment systems (no spent ion exchange resin, spent GAC or RO rejectate to dispose).	1- Would require some extraction and discharge of groundwater into onsite or containerized wetlands.	2- Perchlorate may be uptaken into vegetation. Constructed wetlands are a more effective technique in growing season than in dormant season.	2- Expenses incurred from maintenance of wetlands, and additional treatment methods if contamination is deep.	2- Few full-scale successful perchlorate applications to base new projects on.
		Bioreactor	Use of microbes and nutrients to biodegrade perchlorate in a bioreactor such as a fluidized bed, packed bed, fixed bed, or hollow fiber membrane biofilm reactor.	4- Microbial reduction of perchlorate produces chloride ions and oxygen.	3- Extraction of contaminated groundwater opens exposure pathways.	4- Reduction of perchlorate produces chloride ions and oxygen.	2- Extraction, reactor equipment and maintenance is relatively costly, but waste generated will be less hazardous (therefore potentially less costly) than that from ion exchange/filtration treatments.	3 - Relatively more difficult to implement than less site invasive approaches (MNA, EISB etc.). Extraction of large volumes of water may be difficult to manage and dispose.
In Situ Treatment	Biological Treatment	Enhanced *In Situ* Bioremediation (EISB)	Injection or emplacement of microbes, nutrients or other amendments into groundwater through injection wells or as a permeable reactive barrier (biobarrier) installed via injection/jetting techniques (vs. trenching) to enhance biological degradation *in situ.*	4- Microbial degradation of perchlorate produces chloride and oxygen.	3- Groundwater remains in the ground (i.e. creates fewer exposure pathways than extraction) Injections can reduce concentrations relatively quickly.	4- Microbial degradation of perchlorate produces chloride and oxygen.	3- Relatively more costly than less invasive approaches (NA, MNA etc.), but treatment occurs *in situ* and does not generate waste.	2- Relatively more difficult to implement than less site invasive approaches (NA, MNA etc.) Injections must be precise in terms of horizontal and vertical location. Potential spills/exposure to injectate must be managed. Permits are typically required to allow reagent injection into groundwater.
		Permeable Reactive Barrier (PRB)	Reactive media (eg., woodchips impregnated with vegetable oil) installed in trench, injected or mixed in using augers in order to immobilize or destroy perchlorate.	4- PRB could promote degradation of perchlorate to chloride and oxygen.	2- Installation of PRB may create exposure pathways. May take long periods of time for all contaminated groundwater to migrate through PRB depending on natural groundwater flow velocity.	2- Can reduce mobility and concentration of perchlorate as long as contact between groundwater and PRB is not affected by seasonal elevation fluctuations.	1- Expenses rapidly increase with increasing wall size and depth.	1- Placement of wall must be precise. Installation could be invasive and requires surface access.

Table 3
Initial Site-Specific Screening of Process Options
Shieldalloy Metallurgical Corporation Superfund Site

General Response Action	Remedial Technology	Process Option	Description	Screening Comments	Retained for Process Evaluation?
No Action (NA)	No Action	No Action	No Action. Groundwater monitoring for perchlorate would not be required.	Will be reevaluated following upcoming sampling.	All processes will be retained and reevaluated in the DSRA based on future groundwater sampling results and OU1 and OU2 status.
Institutional Controls	Monitoring	Groundwater Monitoring	Periodic sampling and analysis of groundwater to monitor and document changes in perchlorate concentrations over time.	Will be reevaluated following upcoming sampling.	
	Use Restrictions	Institutional Restrictions	Institutional controls will be established to prevent risk to human health or the environment due to groundwater use.	Potentially applicable; already in place.	
Monitored Natural Attenuation (MNA)	MNA	MNA	Long-term monitoring of natural attenuation mechanisms, including biotic and abiotic degradation/transformation, dispersion and dilution.	Potentially applicable; subject to groundwater test results. Future investigations should look for denitrification properties in groundwater, since redox conditions can support natural attenuation of perchlorate.	
Collection/Containment	Extraction	Extraction Wells	Use of existing and/or installation of additional extraction wells to extract contaminated groundwater and control groundwater migration.	Potentially applicable; would support *ex situ* process options.	
	Containment	Vertical Barrier Walls (VBWs)	Use of VBWs which are composed of native soils enriched with bentonite or another type of clay, and are used to control mass flux and migration of contamination in the subsurface. Other materials such as cement, geomembranes, grout curtains and steel sheet piling can also be used separately or in combination.	Potentially applicable, especially if plume has shrunk since 2011 and is no longer deepening.	
		Pressure Grouting	Injection of grout to reduce permeability within or below the containment area, and subsequently reduce infiltration and/or transport downgradient.	Potentially applicable, especially if plume has shrunk since 2011 and is no longer deepening.	
Collection Enhancements	Extraction Enhancement	Recharge	Injection of water into the subsurface to flush the target zone and enhance mass removal at the extraction well.	Potentially applicable; may promote improved perchlorate flushing and collection.	
Ex Situ Treatment	Physical Treatment	Ion exchange/Adsorption	Use of resins that promote anion exchange for perchlorate removal.	Potentially applicable; site has seen success with ion exchange for reducing other COC concentrations. Disposal of resulting spent resin adds cost. Perchlorate removal is possibly inhibited by presence of dissolved solids.	
		Filtration	Use of filtration (tailored granular activated carbon (GAC), biologically active carbon (BAC), reverse osmosis (RO), etc.) to remove perchlorate ions.	Potentially applicable; disposal of spent GAC or RO rejectate adds cost.	
	Biological Treatment	Constructed Treatment Wetlands/Phytoremediation	Use of engineered wetland to biodegrade perchlorate in wetland sediments.	Potentially applicable; parts of the site are classified as wetlands and wetland restoration is scheduled to occur as part of OU2 remedial activities.	
		Bioreactor	Use of microbes and nutrients to biodegrade perchlorate in a bioreactor such as a fluidized bed, packed bed, fixed bed, or hollow fiber membrane biofilm reactor.	Potentially applicable; presence of elevated nitrate dramtically increases cost.	
In Situ Treatment	Biological Treatment	Enhanced Bioremediation	Injection or emplacement of microbes, nutrients or other amendments into groundwater through injection wells or as a permeable reactive barrier (biobarrier) installed via injection/jetting techniques (vs. trenching) to enhance biological degradation *in situ* .	Potentially applicable; emulsified vegetable oil (EVO) injections in groundwater have promoted microbial dechlorination of TCE in OU1.	
		Permeable Reactive Barrier (PRB)	Reactive media (e.g., woodchips impregnated with vegetable oil) installed in trench, injected or mixed in using augers in order to immobilize or destroy perchlorate.	Potentially applicable, especially if plume has shrunk since 2011 and is no longer deepening.	

FIGURES



Legend

Site Property Boundary

N

0 1,680 Feet

Notes
Base Map: USGS Topographic Map

Site Location

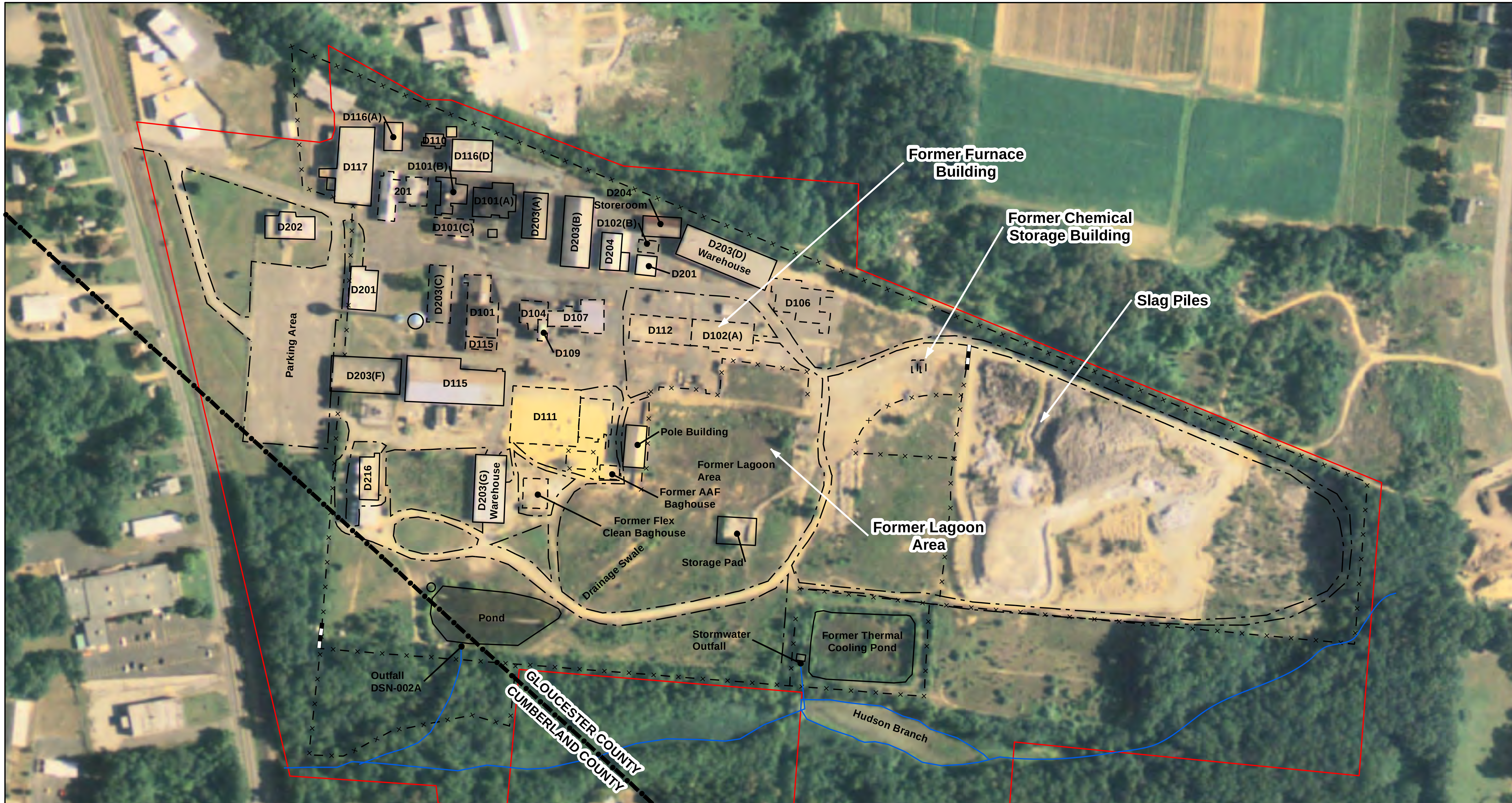
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

Blue Bell, PA | May 2019

Figure 1

P:\GIS\GISprojects\JR0241 - Sheildalloy\Fig 1 Site Location Map.mxd 1/22/2019 11:22:11 AM



Legend

- Site Property Boundary
- Current Building
- Demolished Building
- Pond
- Road
- Fence Line
- Stream
- Gate

N

0 280 Feet

SMC Manufacturing Facility and AOCs

SheildAlloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

Figure 2

Blue Bell, PA | May 2019

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ATTACHMENT A

Previous Perchlorate Analytical Results

TABLE 2-1
Groundwater Perchlorate Results Summary - 2004 Through 2011
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

WELL IDENTIFIER	SCREENED INTERVAL (FTBGS)[1]	RELATIVE AQUIFER DEPTH	PERCHLORATE (µg/L) SAMPLING EVENT							
			JULY 27, 2004	SEPTEMBER 10, 2004	SEPTEMBER 30, 2004	OCTOBER 27, 2004	FEBRUARY 21, 2006	OCTOBER 20-22, 2009[2]	SEPTEMBER 8-9, 2010	APRIL 29, 2011
ON-SITE MONITORING WELLS										
IWC-1	15-20	Shallow	**9.9**	**10.0**	NA	NA	NA	**7.3**	NA	NA
IWC-2	35-40	Shallow	**10**	**9.4**	NA	NA	NA	**7.7**	NA	NA
IWC-3	55-60	Intermediate	4.0 / 4.1	4.0 / 4.0	NA	NA	NA	2.5 J [3]	NA	NA
IWC-4	75-80	Intermediate	**5.4**	**6.9**	NA	NA	NA	4.6	4.4	NA
IWC-5	95-100	Deep	**10.0**	**11.0**	NA	NA	NA	**11.7 / 10.7[4]**	NA	NA
A	114-124	Deep	NA	<0.18	NA	NA	NA	<3.0	NA	NA
B	36-46	Shallow	NA	**8.0**	NA	NA	NA	1.2 J [3]	NA	NA
K	36-46	Shallow	NA	NA	NA	NA	NA	**90.5 / 78.1**	1.9 J[6] / 3.0	NA
L	42-52	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC9S	15-30	Shallow	NA	**8.0**	NA	NA	NA	**8.2 / 8.0[5]**	NA	NA
SC11S(R)	9-24	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC12S	15-25	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC12D	126-136	Deep	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC13S(R)	14.7-24.7	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC13D	127-137	Deep	NA	NA	NA	NA	NA	2.2 J [6]	NA	NA
SC14S	12-27	Shallow	NA	0.21 J	NA	NA	NA	<3.0	<3.0	NA
SC15S	12.5-27.5	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC16S	12-27	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC20S	7-22	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC20D	129-139	Deep	NA	NA	NA	NA	NA	**7.0**	**6.0**	NA
SC22S	3-18	Shallow	NA	NA	NA	NA	NA	<3.0	2.0 J[6]	NA
SC23S	9-24	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC25S	7-22	Shallow	NA	NA	NA	NA	NA	<3.0	0.64 J[6]	NA
SC27S	7-22	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
MWH-4	119-129	Deep	NA	NA	NA	NA	NA	<3.0	NA	NA
W2(R)	2-17	Shallow	NA	NA	NA	NA	NA	0.94 J [6]	<3.0	NA
W3D	88-108	Deep	NA	NA	NA	NA	NA	**8.6**	**7.4**	NA
W4	55-75	Intermediate	NA	NA	NA	NA	NA	1.2 J[6]	0.93 J[6]	NA

NOTES:

(1) - FTBGS, Feet Below Ground Surface
(2) - Monitoring wells SC33D & SC34D were sampled on 11/19/09, monitoring wells SC35D & SC36D were sampled on 12/7/09, monitoring well K was re-sampled on 1/21/10, & recovery wells Layne & W9 were sampled on 1/21/10
(3) - Data qualifier changed to "J" by data validation
(4) - "Blind" duplicate sample labeled as IWC-6
(5) - "Blind" duplicate sample labeled as SC33S
(6) - Data not validated, but qualifier changed to "J" consistent with data validation
(7) - Data validation corrected reporting limit
(8) - "Blind" duplicate sample labeled as SC35D
(9) - "Blind" duplicate sample labeled as SC37D
(10) - "Blind" duplicate sample labeled as SC34D

µg/L - micrograms per liter
NA - Not Analyzed
All samples were analyzed by EPA Method 314.0
BOLD - indicates that value is greater than the perchlorate action level of 5 µg/L (2006 ACO)
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
J - Indicates a result is less than the reporting limit and estimated by the laboratory
Results with slash (e.g., 13.0 / 12.9) indicate duplicate results

TABLE 2-1
Groundwater Perchlorate Results Summary - 2004 Through 2011
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

WELL IDENTIFIER	SCREENED INTERVAL (FTBGS)(1)	RELATIVE AQUIFER DEPTH	PERCHLORATE (µg/L) SAMPLING EVENT							
			JULY 27, 2004	SEPTEMBER 10, 2004	SEPTEMBER 30, 2004	OCTOBER 27, 2004	FEBRUARY 21, 2006	OCTOBER 20-22, 2009(2)	SEPTEMBER 8-9, 2010	APRIL 29, 2011
OFF-SITE MONITORING WELLS										
OBS-2A	129-149	Deep	NA	NA	NA	NA	NA	4.8 J (6)	NA	NA
IW1	32-62	Intermediate	NA	NA	NA	NA	NA	1.1 J (6)	NA	NA
SC4S	35-45	Shallow	NA	NA	1.1	NA	NA	<3.0	NA	NA
SC6S	45-75	Intermediate	NA	NA	1.6	NA	NA	**6.4**	**19.6**	NA
SC6D	110-120	Deep	NA	NA	3.5	NA	NA	**9.8**	NA	NA
SC10S	35-55	Shallow	NA	NA	NA	NA	NA	1.7 J (6)	<3.0	NA
SC10D	105-125	Deep	NA	NA	NA	NA	NA	**19.5**	**8.5**	NA
SC17S	19-28	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC17D	143-153	Deep	NA	NA	NA	NA	NA	**6.3**	**5.6**	NA
SC18S	4-19	Shallow	NA	NA	NA	NA	NA	<15.0 (7)	<3.0	NA
SC18D	119-129	Deep	NA	NA	NA	NA	NA	3.8	NA	NA
SC19S	2-17	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC19D	120-130	Deep	NA	NA	NA	NA	NA	**14.3**	NA	NA
SC21S	3-18	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC21D	125-135	Deep	NA	NA	NA	NA	NA	**29.1**	**32.8**	NA
SC26D	127-137	Deep	NA	NA	NA	NA	NA	**11.0**	**6.8**	NA
SC28D	133-153	Deep	NA	NA	NA	**34.0**	NA	**49.0**	**16.8**	NA
SC30D	147-157	Deep	NA	NA	NA	1.9	NA	2.6 J (6)	2.8 J(6)	NA
SC32D	92-102	Deep	NA	NA	NA	NA	NA	3.2 / 3.3(8)	3.7	NA
SC33D	82.5-92.5	Intermediate	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC34D	130-140	Deep	NA	NA	NA	NA	NA	**150 / 152(9)**	**158**	NA
SC35D	89.5-99.5	Deep	NA	NA	NA	NA	NA	2.0 J (6)	2.7 J(6)	NA
SC36D	107-117	Deep	NA	NA	NA	NA	NA	**5.3**	**6.4 / 5.6(9)**	NA
SC40D	120-130	Deep	NA	NA	NA	NA	NA	NA	NA	4.0 / 3.9 (11)
ON-SITE EXTRACTION WELLS										
Layne	42-47	Shallow	NA	**23.0**	NA	NA	NA	**67.4**	**36.6**	NA
W9	110-130	Deep	NA	**10.0**	NA	NA	NA	**6.1**	NA	NA

NOTES:

(1) - FTBGS, Feet Below Ground Surface
(2) - Monitoring wells SC33D & SC34D were sampled on 11/19/09, monitoring wells SC35D & SC36D were sampled on 12/7/09, monitoring well K was re-sampled on 1/21/10, & recovery wells Layne & W9 were sampled on 1/21/10
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(5) - "Blind" duplicate sample labeled as SC33S
(6) - Data not validated, but qualifier changed to "J" consistent with data validation
(7) - Data validation corrected reporting limit
(8) - "Blind" duplicate sample labeled as SC35D
(9) - "Blind" duplicate sample labeled as SC37D
(10) - "Blind" duplicate sample labeled as SC34D
(11) - "Blind" duplicate sample labeled as SC49D

µg/L - micrograms per liter
NA - Not Analyzed
All samples were analyzed by EPA Method 314.0
BOLD - indicates that value is greater than the perchlorate action level of 5 µg/L (2006 ACO)
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
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Results with slash (e.g., 13.0 / 12.9) indicate duplicate results

TABLE 2-1
Groundwater Perchlorate Results Summary - 2004 Through 2011
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

WELL IDENTIFIER	SCREENED INTERVAL (FTBGS)(1)	RELATIVE AQUIFER DEPTH	PERCHLORATE (µg/L) SAMPLING EVENT							
			JULY 27, 2004	SEPTEMBER 10, 2004	SEPTEMBER 30, 2004	OCTOBER 27, 2004	FEBRUARY 21, 2006	OCTOBER 20-22, 2009(2)	SEPTEMBER 8-9, 2010	APRIL 29, 2011
FARM PARCEL MONITORING WELLS										
IW2	40-70	Intermediate	NA	NA	NA	NA	NA	3.7	NA	NA
SC1S	35-55	Intermediate	NA	NA	NA	3.5	**8.8**	1.8 J (3)	0.69 J(3)	NA
SC1D	85-95/100-115	Deep	NA	NA	NA	**76.0 / 76.0**	**53.9**	**46.3**	**44.5**	NA
SD2D(R)	106-116	Deep	NA	NA	**9.2**	NA	NA	**7.0**	**6.6**	NA
SC3S	35-55	Intermediate	NA	NA	**13**	NA	**20.9**	1.8 J (3)	**13.0**	NA
SC3D(R)	102-112	Deep	NA	NA	**49**	NA	**62.1**	**141 / 136(10)**	**143**	NA
SC5S	5-20	Shallow	NA	NA	NA	NA	NA	1.4 J (6)	NA	NA
SC5D	90-120	Deep	NA	NA	NA	NA	NA	1.2 J (6)	NA	NA
SC24S	5-20	Shallow	NA	NA	NA	4.8	4.3	0.99 J (6)	2.1 J(3)	NA
SC24D	105-115	Deep	NA	NA	NA	**6**	3.0	3.0	NA	NA
SC31D	120-130	Deep	NA	NA	NA	NA	NA	**6.6**	NA	NA
OFFSITE EXTRACTION WELLS										
RIW2	30-55	Shallow	NA	NA	**14.0 / 15.1**	NA	**9.4**	4.1	NA	NA
RW6S	55-75	Intermediate	NA	NA	**8.0 / 8.01**	NA	NA	**12.9**	NA	NA
RW6D	90-125	Deep	NA	NA	**12.0 / 13.8**	NA	NA	**14.3**	NA	NA

NOTES:

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(10) - "Blind" duplicate sample labeled as SC34D

µg/L - micrograms per liter
NA - Not Analyzed / Not Applicable
All samples were analyzed by EPA Method 314.0
BOLD - indicates that value is greater than the perchlorate action level of 5 µg/L (2006 ACO)
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
J - Indicates a result is less than the reporting limit and estimated by the laboratory
Results with slash (e.g., 13.0 / 12.9) indicate duplicate results

TABLE 2-2
Current and Previous Off-Site Groundwater Vertical Profiling Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Approx. Ground Surface Elevation (ftmsl)	Sample Depth (ftbgs)	Approx. Sample Elevation (ftmsl)	Relative Aquifer Depth	Perchlorate (ug/L)
Vertical Profile Samples (2009 Investigation)						
VP-13 (25-30)	10/14/2009	102	25-30	77 to 72	Shallow	<3.0
VP-13 (50-55)	10/14/2009	102	50-55	52 to 47	Shallow	<3.0
VP-13 (75-80)	10/14/2009	102	75-80	27 to 22	Intermediate	3.9
VP-13 (100-105)	10/15/2009	102	100-105	2 to -3	Deep	**10.6**
VP-13 (125-130)	10/15/2009	102	125-130	-23 to -28	Deep	**5.7**
VP-13A (15-20)	10/22/2009	89	15-20	74 to 69	Shallow	<3.0
VP-13A (37-42)	10/22/2009	89	37-42	52 to 47	Shallow	<3.0
VP-13A (62-67)	10/22/2009	89	62-67	27 to 22	Intermediate	4.3
VP-13A (87-92)	10/23/2009	89	87-92	2 to -3	Deep	3.4
VP-13A (111-116)	10/23/2009	89	111-116	-22 to -27	Deep	**6.0**
VP-14 (35-40)	10/16/2009	100	35-40	65 to 60	Shallow	0.93 J (2)
VP-14 (55-60)	10/16/2009	100	55-60	45 to 40	Shallow	<3.0
VP-14 (80-85)	10/19/2009	100	80-85	20 to 15	Intermediate	1.6 J (1)
VP-14 (105-110)	10/19/2009	100	105-110	-5 to -10	Deep	**6.2**
VP-24 (105-110) Field Dup	10/19/2009	100	105-110	-5 to -10	Deep	**5.9**
VP-14 (130-135)	10/19/2009	100	130-135	-30 to -35	Deep	**12.5**
VP-15 (30-35)	10/12/2009	91	30-35	61 to 56	Shallow	<3.0
VP-15 (45-50)	10/12/2009	91	45-50	46 to 41	Shallow	<3.0
VP-15 (65-70)	10/13/2009	91	65-70	26 to 21	Intermediate	<3.0
VP-15 (88-93)	10/13/2009	91	88-93	3 to -2	Deep	4.9
VP-15 (114-119)	10/13/2009	91	114-119	-23 to -28	Deep	<3.0
VP-15A (15-20)	10/20/2009	76	15-20	61 to 56	Shallow	<3.0
VP-15A (38-43)	10/21/2009	76	38-43	38 to 33	Shallow	<3.0
VP-15A (55-60)	10/21/2009	76	55-60	21 to 16	Intermediate	<3.0
VP-15A (77-82)	10/21/2009	76	77-82	-1 to -6	Deep	1.6 J (2)
VP-15A (99-104)	10/21/2009	76	99-104	-23 to -28	Deep	2.5 J (2)
VP-25A (99-104) Field Dup	10/21/2009	76	99-104	-23 to -28	Deep	2.9 J (2)

NOTES:
(1) - Data qualifier changed to "J" by data validation
(2) - Data not validated, but qualifier changed to "J" consistent with data validation
BOLD - indicates that value is greater that the perchlorate action level of 5 μg/L
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 μg/L
micrograms per Liter (μg/L) is equivalent to parts per billion
ftmsl - feet above mean sea level (NAVD 27)
ftbgs - feet below ground surface
J - Indicates a result is less than the reporting limit and estimated by the laboratory

TABLE 2-2
Current and Previous Off-Site Groundwater Vertical Profiling Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Approx. Ground Surface Elevation (ftmsl)	Sample Depth (ftbgs)	Approx. Sample Elevation (ftmsl)	Relative Aquifer Depth	Perchlorate (ug/L)
Vertical Profile Samples (2006/2007 Investigation)						
VP-1 (15-20)	11/28/2006	85	15-20	70 to 65	Shallow	<0.3
VP-1 (35-40)	11/28/2006	85	35-40	50 to 45	Shallow	<0.3
VP-1 (60-65)	11/29/2006	85	60-65	25 to 20	Intermediate	<0.3
VP-1 (85-90)	11/29/2006	85	85-90	0 to -5	Deep	**5.6**
VP-1 (105-110)	11/29/2006	85	105-110	-20 to -25	Deep	3.0
VP-2 (15-20)	11/30/2006	85	15-20	70 to 65	Shallow	<0.3
VP-2 (35-40)	12/1/2006	85	35-40	50 to 45	Shallow	4.2
VP-2 (60-65)	12/1/2006	85	60-65	25 to 20	Intermediate	**9.6**
VP-2 (85-90)	12/1/2006	85	85-90	0 to -5	Deep	**49.9**
VP-2 (110-115)	12/1/2006	85	110-115	-25 to -30	Deep	**9.4**
VP-3 (25-30)	12/4/2006	95	25-30	70 to 65	Shallow	<0.3
VP-3 (45-50)	12/5/2006	95	45-50	50 to 45	Shallow	<0.3
VP-30 (45-50) Field Dup	12/5/2006	95	45-50	50 to 45	Shallow	<0.3
VP-3 (70-75)	12/6/2006	95	70-75	25 to 20	Intermediate	**7.9**
VP-3 (95-100)	12/6/2006	95	95-100	0 to -5	Deep	**34**
VP-3 (115-120)	12/6/2006	95	115-120	-20 to -25	Deep	**28.3**
VP-4 (30-35)	12/11/2006	100	30-35	70 to 65	Shallow	1.3
VP-4 (50-55)	12/11/2006	100	50-55	50 to 45	Intermediate	1.3
VP-4 (75-80)	12/11/2006	100	75-80	25 to 20	Intermediate	3.3
VP-4 (75-80) Field Dup	12/11/2006	100	75-80	25 to 20	Intermediate	3.1
VP-4 (100-105)	12/11/2006	100	100-105	0 to -5	Deep	<0.3
VP-4 (121-126)	12/11/2006	100	121-126	-21 to -26	Deep	**6.8**
VP-10 (20-25)	12/15/2006	85	20-25	65 to 60	Shallow	2.4
VP-10 (35-40)	12/15/2006	85	35-40	50 to 45	Shallow	<0.3
VP-10 (60-65)	12/18/2006	85	60-65	25 to 20	Intermediate	3.4
VP-100 (60-65) Field Dup	12/18/2006	85	60-65	25 to 20	Intermediate	3.4
VP-10 (85-90)	12/18/2006	85	85-90	0 to -5	Deep	**17.4**
VP-10 (109-114)	12/18/2006	85	109-114	-24 to -29	Deep	**6.7**

NOTES:

(1) - Data qualifier changed to "J" by data validation
(2) - Data not validated, but qualifier changed to "J" consistent with data validation
BOLD - indicates that value is greater that the perchlorate action level of 5 µg/L
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
micrograms per Liter (µg/L) is equivalent to parts per billion
ftmsl - feet above mean sea level (NAVD 27)
ftbgs - feet below ground surface

TABLE 2-3
Soil Investigation Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Sample Depth (ftbgs)	Perchlorate (ug/kg)
Background Sample			
SS-01 (0-1')	8/30/2012	0-1	<1.2
SS-01 (5-7')	10/26/2009	5-7	<9.6
SS-01 (12-14')	10/26/2009	12-14	<10
AOC-1 Former Chemical Storage Building			
SS-02 (1-3')	10/26/2009	1-3	2.1 J(1)
SS-02 (14-16')	10/26/2009	14-16	<9.7
SS-03 (0-2')	10/26/2009	0-2	<10
SS-03 (13-15')	10/26/2009	13-15	8.6 J(1)
SS-04 (0-1')	8/30/2012	0-1	<1.2
SS-04 (2-4')	10/26/2009	2-4	7.9 J(1)
SS-04 (14-16')	10/26/2009	14-16	4.2 J(1)
SS-05 (0-1')	8/30/2012	0-1	<1.2
SS-05 (5-7')	10/26/2009	5-7	58.3
SS-05 (13-15')	10/26/2009	13-15	18.3
SS-06 (1-3')	10/26/2009	1-3	<10
SS-06 (14-16')	10/26/2009	14-16	2.9 J(1)
SS-07 (6-8')	10/26/2009	6-8	<9.6
SS-27 (6-8') Field Dup	10/26/2009	6-8	<9.6
SS-07 (13-15')	10/26/2009	13-15	3.0 J(1)
SS-08 (3-4')	10/26/2009	3-4	<9.9
SS-08 (12-14')	10/26/2009	12-14	<9.6
AOC-2 Former Building D102(A)			
SS-21 (0-1')	8/30/2012	0-1	5.9 J(1)
SS-21 (1-3')	10/28/2009	1-3	11.0
SS-21 (5-7')	10/28/2009	5-7	10.7
SS-22 (1-3')	10/28/2009	1-3	<9.8
SS-22 (6-8')	10/28/2009	6-8	12.0
SS-23 (2-4')	10/28/2009	2-4	<10
SS-33 (2-4') Field Dup	10/28/2009	2-4	<10
SS-23 (6-8')	10/28/2009	6-8	<9.7
SS-24 (0-1')	8/30/2012	0-1	<1.2
SS-24 (1-3')	10/28/2009	1-3	26.5
SS-24 (4-6')	10/28/2009	4-6	28.8

Sample ID	Date Sampled	Sample Depth (ftbgs)	Perchlorate (ug/kg)
AOC-3 Former Lagoon Area			
SS-09 (0-1')	8/30/2012	0-1	<1.2
SS-09 (6-8')	10/26/2009	6-8	<10
SS-09 (12-14')	10/26/2009	12-14	<10
SS-10 (2-4')	10/26/2009	2-4	<9.8
SS-10 (4-6')	10/26/2009	4-6	<9.4
SS-11 (1-3')	10/27/2009	1-3	<9.8
SS-11 (5-7')	10/27/2009	5-7	2.8 J(2)
SS-12 (2-4')	10/27/2009	2-4	<9.7
SS-12 (5-7')	10/27/2009	5-7	<9.6
SS-32 (5-7') Field Dup	10/27/2009	5-7	<9.6
SS-13 (0-1')	8/30/2012	0-1	<1.2
SS-13 (1-3')	10/27/2009	1-3	2.0 J(2)
SS-13 (5-7')	10/27/2009	5-7	2.9 J(2)
SS-14 (1-3')	10/27/2009	1-3	<9.5
SS-14 (6-8')	10/27/2009	6-8	<9.6
SS-15 (0-1')	8/30/2012	0-1	<1.2
SS-15 (2-4')	10/27/2009	2-4	<9.7
SS-15 (4-6')	10/27/2009	4-6	<9.9
SS-16 (1-3')	10/27/2009	1-3	<9.6
SS-16 (6-8')	10/27/2009	6-8	<9.9
SS-17 (1-3')	10/27/2009	1-3	<9.7
SS-17 (5-7')	10/27/2009	5-7	2.8 J(2)
SS-18 (1-3')	10/27/2009	1-3	<10
SS-18 (6-8')	10/27/2009	6-8	<9.3
SS-19 (1-3')	10/27/2009	1-3	<9.8
SS-19 (6-8')	10/27/2009	6-8	<9.6
SS-20 (0-1')	8/30/2012	0-1	<1.2
SS-20 (1-3')	10/27/2009	1-3	2.3 J(2)
SS-20 (4-6')	10/27/2009	4-6	<10

NOTES:

(1) - Data qualifier changed to "J" by data validation

(2) - Data not validated, but qualifier changed to "J" consistent with data validation

EPA Regional Screening Level for perchlorate in residential soil is 55,000 µg/kg and 720,000 µg/kg in industrial soil.

Shaded results are in excess of the EPA Regional Screening Level for perchlorate.

micrograms per Liter (µg/kg) is equivalent to parts per billion

ftbgs - feet below ground surface

J - Indicates a result is less than the reporting limit and estimated by the laboratory

TABLE 2-4
Soil Investigation, Monitoring/Extraction Well Sampling, Groundwater Vertical Profiling, and Surface Water and Sediment QA/QC Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Perchlorate (µg/L)
Soil / Sediment Investigation Field Blank Samples		
FB102609(1)	10/26/2009	<3.0
FB102609(2)	10/26/2009	<3.0
FB102709(1)	10/27/2009	<3.0
FB102709(2)	10/27/2009	<3.0
FB102809(for SS Samples)	10/28/2009	<3.0
FB102809(for SED Samples)	10/28/2009	<3.0
Monitoring/Extraction Well Sampling Field Blank Samples		
FB102009A	10/20/2009	<3.0
FB102109	10/21/2009	<3.0
FB102209	10/22/2009	<3.0
FB111909	11/19/2009	<3.0
FB090810	9/8/2010	<3.0
FB090910	9/9/2010	<3.0
FB042911	4/29/2011	<3.0
Groundwater Vertical Profiling Field Blank Samples		
FB101209	10/12/2009	<3.0
FB101309	10/13/2009	<3.0
FB101409	10/14/2009	<3.0
FB101509	10/15/2009	<3.0
FB101609	10/16/2009	<3.0
FB101909	10/19/2009	<3.0
FB102009	10/20/2009	<3.0
FB102109	10/21/2009	<3.0
FB102209	10/22/2009	<3.0
FB102309	10/23/2009	<3.0
Environmental Samples / "Blind" Duplicate Samples		
Monitoring Well Sampling		
IWC-5 / IWC-6	10/21/2009	11.7 / 10.7
SC9S / SC33S	10/21/2009	8.2 / 8.0
SC32D / SC35D	10/22/2009	3.2 / 3.3
SC3D(R) / SC34D	10/21/2009	141 / 136
SC34D / SC37D	11/19/2009	150 / 152
SC36D / SC37D	9/8/2010	6.4 / 5.6
SC40D / SC49D	4/29/2011	4.0 / 3.9
K / J	9/9/2010	1.9J / 3.0
Groundwater Vertical Profiling		
VP-14(105-110) / VP-24(105-110)	10/19/2009	6.2 / 5.9
VP-15A(99-104) / VP-25A(99-104)	10/21/2009	2.5J / 2.9J
Soil Investigation*		
SS-07(6-8') / SS-27(6-8')	10/26/2009	<9.6 / <9.6
SS-12(5-7') / SS-32(5-7')	10/27/2009	<9.6 / <9.6
SS-23(2-4') / SS-33(2-4')	10/28/2009	<10 / <10
Surface Water / Sediment Investigation		
SED-4 / SED-10*	10/28/2009	10.9J / <42
SW-4 / SW-10	10/28/2009	<3.0 / <3.0

NOTES:

Action Level for Perchlorate is 5 µg/L (per Administrative Consent Order signed February 1, 2006).

micrograms per Liter (µg/L) is equivalent to parts per billion

J - Indicates a result is less than the reporting limit and estimated by the laboratory

* - Soil and sediment perchlorate results are presented in micrograms per kilogram (µg/kg)

TABLE 2-5
Surface Water and Sediment Investigation Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Perchlorate	
		Surface Water (ug/l)	Sediment (ug/kg)
Surface Water / Sediment Sample Identifications			
SW-1A / SED-1A	10/28/2009	1.8 J (1)	<12
SW-1 / SED-1	10/28/2009	<3.0	<18
SW-2 / SED-2	10/28/2009	<3.0	<19 (2)
SW-3 / SED-3	10/28/2009	<3.0	<13
SW-4 / SED-4	10/28/2009	<3.0	10.9 J (1)
SW-10 / SED-10 Field Dup	10/28/2009	<3.0 (2)	<42
SW-5 / SED-5	10/28/2009	<3.0	<27
SW-6 / SED-6	10/28/2009	<3.0	<16
SW-7 / SED-7	10/29/2009	<3.0	<21
SED-8	10/29/2009	Dry	<11
SW-9 / SED-9	10/29/2009	<3.0	<47

NOTES:

(1) - Data qualifier changed to "J" by data validation

(2) - Data validation indicated analytical result should be reported as less than the laboratory reporting limit

There are no established guidance or criteria for perchlorate in surface water or sediment

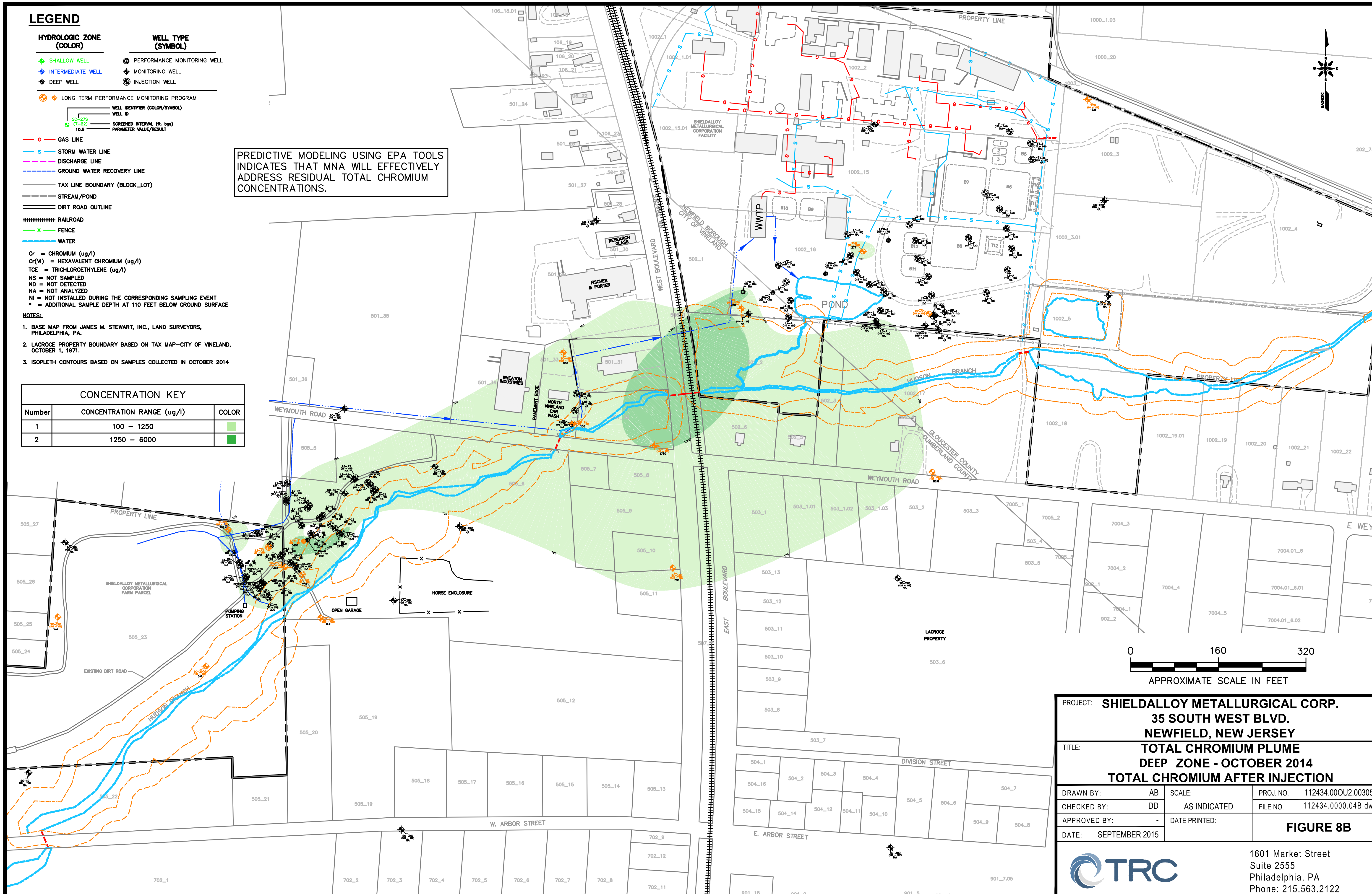
micrograms per Liter (μg/L) is equivalent to parts per billion

ftmsl - feet above mean sea level (NAVD 27)

ftbgs - feet below ground surface

J - Indicates a result is less than the reporting limit and estimated by the laboratory

ATTACHMENT B
OU1, OU2 and OU3 Footprint Comparisons



LEGEND

HYDROLOGIC ZONE (COLOR)
- SHALLOW WELL
- INTERMEDIATE WELL
- DEEP WELL

WELL TYPE (SYMBOL)
- PERFORMANCE MONITORING WELL
- MONITORING WELL
- INJECTION WELL

LONG TERM PERFORMANCE MONITORING PROGRAM

SC-27S (7-22) 10.5
- WELL IDENTIFIER (COLOR/SYMBOL)
- WELL ID
- SCREENED INTERVAL (ft. bgs)
- PARAMETER VALUE/RESULT

- G — GAS LINE
- S — STORM WATER LINE
- DISCHARGE LINE
- GROUND WATER RECOVERY LINE
- TAX LINE BOUNDARY (BLOCK_LOT)
- STREAM/POND
- DIRT ROAD OUTLINE
- RAILROAD
- X — FENCE
- WATER

Cr = CHROMIUM (ug/l)
Cr(VI) = HEXAVALENT CHROMIUM (ug/l)
TCE = TRICHLOROETHYLENE (ug/l)
NS = NOT SAMPLED
ND = NOT DETECTED
NA = NOT ANALYZED
NI = NOT INSTALLED DURING THE CORRESPONDING SAMPLING EVENT
* = ADDITIONAL SAMPLE DEPTH AT 110 FEET BELOW GROUND SURFACE

NOTES:

1. BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA.
2. LACROCE PROPERTY BOUNDARY BASED ON TAX MAP—CITY OF VINELAND, OCTOBER 1, 1971.
3. ISOPLETH CONTOURS BASED ON SAMPLES COLLECTED IN OCTOBER 2014

PREDICTIVE MODELING USING EPA TOOLS INDICATES THAT MNA WILL EFFECTIVELY ADDRESS RESIDUAL TOTAL CHROMIUM CONCENTRATIONS.

CONCENTRATION KEY

Number	CONCENTRATION RANGE (ug/l)	COLOR
1	100 – 1250	
2	1250 – 6000	

0 160 320
APPROXIMATE SCALE IN FEET

PROJECT: **SHIELDALLOY METALLURGICAL CORP.**
35 SOUTH WEST BLVD.
NEWFIELD, NEW JERSEY

TITLE: **TOTAL CHROMIUM PLUME**
DEEP ZONE - OCTOBER 2014
TOTAL CHROMIUM AFTER INJECTION

DRAWN BY: AB	SCALE: AS INDICATED	PROJ. NO. 112434.00OU2.003050
CHECKED BY: DD		FILE NO. 112434.0000.04B.dwg
APPROVED BY: -	DATE PRINTED:	**FIGURE 8B**
DATE: SEPTEMBER 2015		

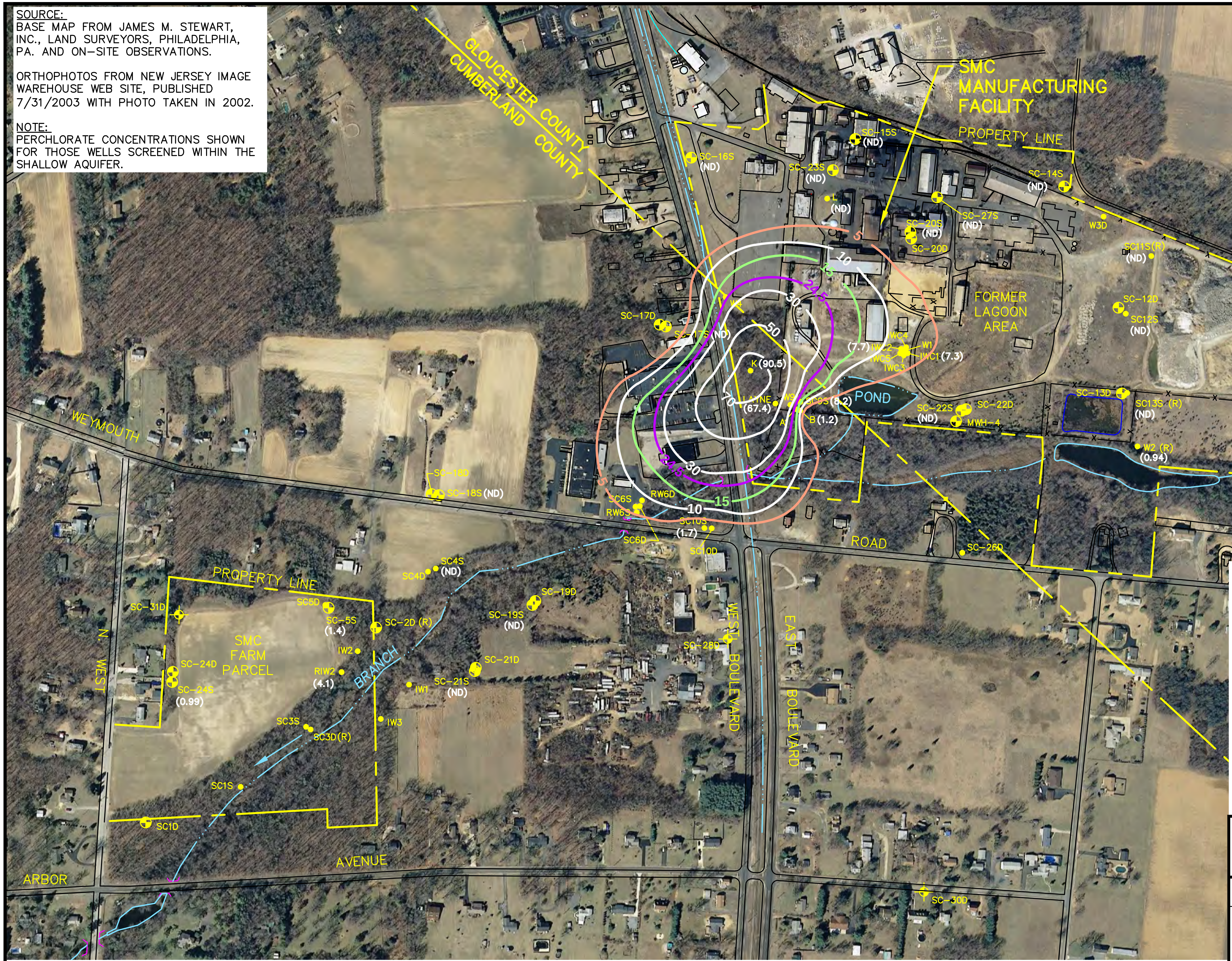
TRC
1601 Market Street
Suite 2555
Philadelphia, PA
Phone: 215.563.2122

PLOT DATA
Drawing Name: \\ntapa-annarbor\aam-vol2\CADD\PJT\00_TRC\Shieldalloy\112434\0000\112434.0000.04B.dwg
Operator Name: ALBERTS, SCOTT
Drawing Plot Scale: 0.386863
Dwg Size: 2.65 Mb
Plot Date: September 1, 2015
Plot Time: 7:10 PM
Attached Xrefs: BASEMAP 2014_06 FOR WELLS BASE
Attached Images: D17D7; D17D8;
Layout: FIG04B CR L Zone After Inj

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 7/31/2003 WITH PHOTO TAKEN IN 2002.

NOTE:
PERCHLORATE CONCENTRATIONS SHOWN FOR THOSE WELLS SCREENED WITHIN THE SHALLOW AQUIFER.



LEGEND

W2 ●	EXISTING WELL LOCATION AND NUMBER
SC18S	RI MONITORING WELL
IW-1 ●	IRRIGATION WELL AND NUMBER
MOHAN ▪	DOMESTIC WELL
(R)	REPLACEMENT WELL
	SUPPLEMENTAL MONITORING WELL (INSTALLED)
— 10 —	PERCHLORATE CONCENTRATION ISOPLETH (ppb)
(7.1)	PERCHLORATE CONCENTRATION IN WELL (ppb)

0 400' 800'

GRAPHIC SCALE

TRC

21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 10-1A
SHALLOW GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - SMC SITE AND FARM PARCEL

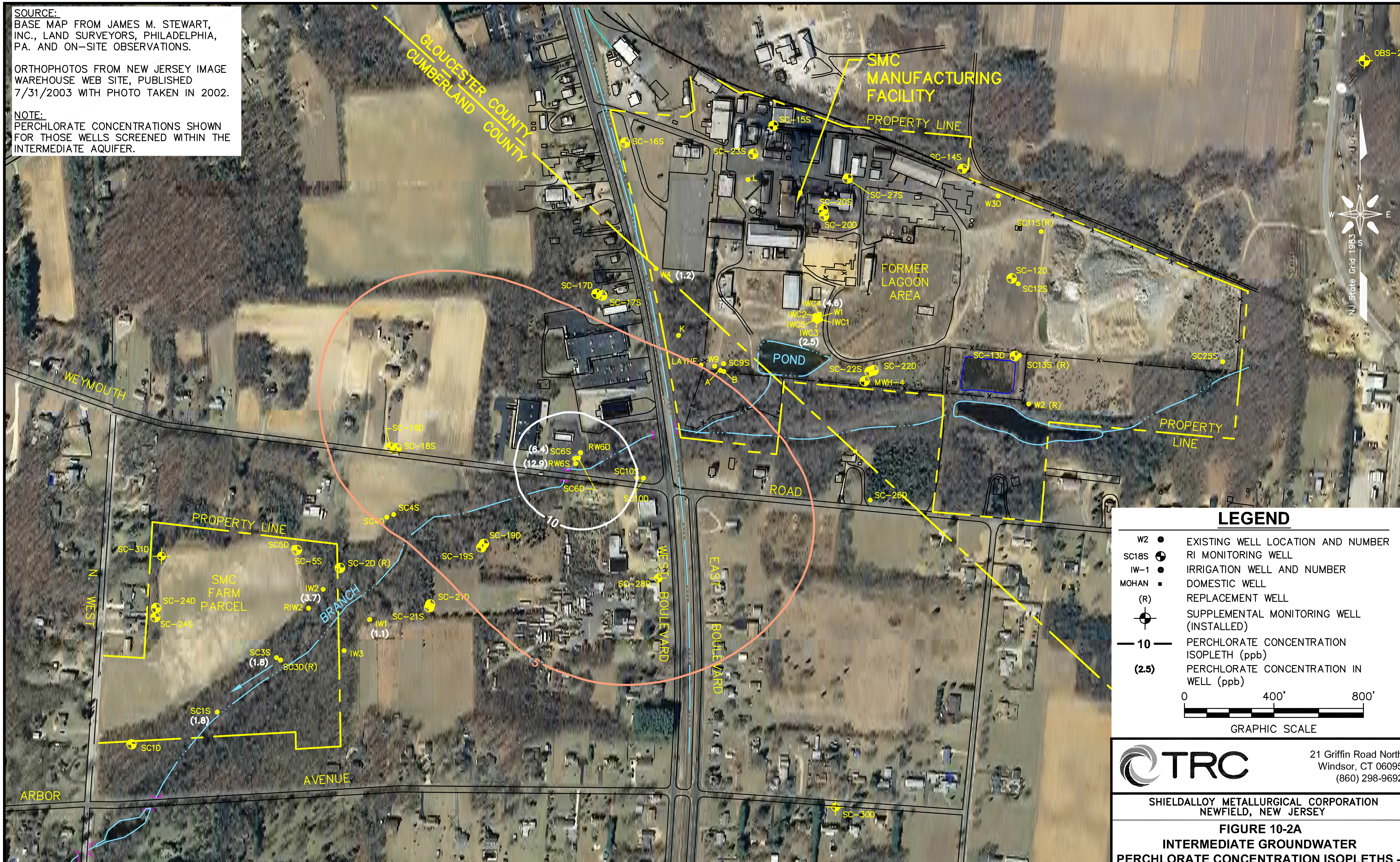
Date: 11/18/10 | Project No. 171441-000050-000000

J:\CAD\171441\000050\Remedial Inv Report\
Plate-1.dwg Layout:FIGURE 10-1A November 19, 2010-1:32PM KHollenbeck

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 7/31/2003 WITH PHOTO TAKEN IN 2002.

NOTE:
PERCHLORATE CONCENTRATIONS SHOWN FOR THOSE WELLS SCREENED WITHIN THE INTERMEDIATE AQUIFER.



LEGEND

W2 ●	EXISTING WELL LOCATION AND NUMBER
SC18S	RI MONITORING WELL
IW-1 ●	IRRIGATION WELL AND NUMBER
MOHAN ▪	DOMESTIC WELL
(R)	REPLACEMENT WELL
	SUPPLEMENTAL MONITORING WELL (INSTALLED)
— 10 —	PERCHLORATE CONCENTRATION ISOPLETH (ppb)
(2.5)	PERCHLORATE CONCENTRATION IN WELL (ppb)

0 400' 800'

GRAPHIC SCALE

TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 10-2A
INTERMEDIATE GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - SMC SITE AND FARM PARCEL

Date: 03/11/10 Project No. 171441-000050-000000

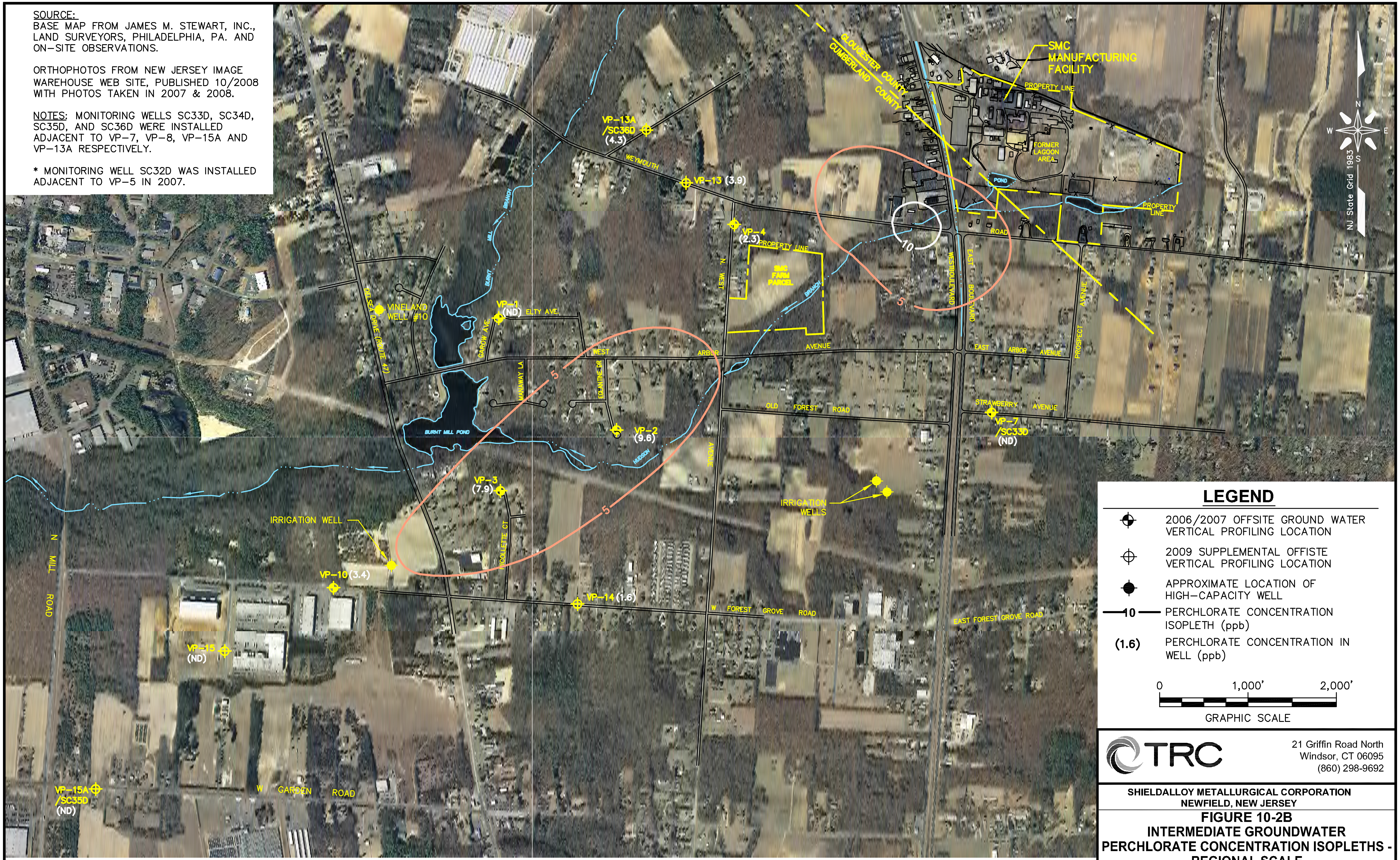
J:\CAD\171441\000050\Remedial Inv Report\Plate-1.dwg Layout:FIGURE 10-2A March 15, 2010-10:27AM KHollenbeck

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 10/2008 WITH PHOTOS TAKEN IN 2007 & 2008.

NOTES: MONITORING WELLS SC33D, SC34D, SC35D, AND SC36D WERE INSTALLED ADJACENT TO VP-7, VP-8, VP-15A AND VP-13A RESPECTIVELY.

* MONITORING WELL SC32D WAS INSTALLED ADJACENT TO VP-5 IN 2007.



LEGEND

⌖	2006/2007 OFFSITE GROUND WATER VERTICAL PROFILING LOCATION
⌖	2009 SUPPLEMENTAL OFFSITE VERTICAL PROFILING LOCATION
●	APPROXIMATE LOCATION OF HIGH-CAPACITY WELL
—10—	PERCHLORATE CONCENTRATION ISOPLETH (ppb)
(1.6)	PERCHLORATE CONCENTRATION IN WELL (ppb)

0 1,000' 2,000'

GRAPHIC SCALE

TRC

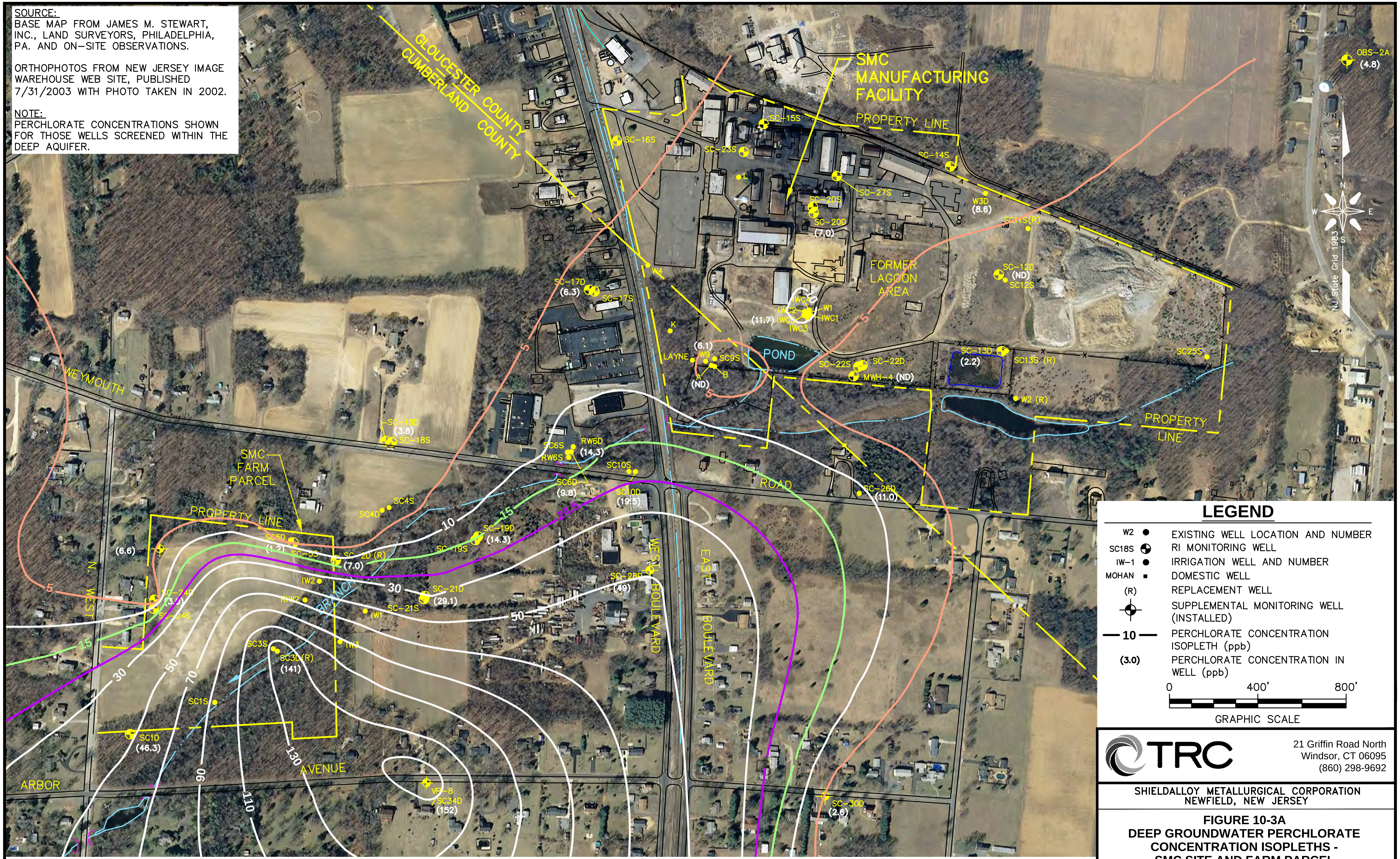
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 10-2B
INTERMEDIATE GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - REGIONAL SCALE

Date: 03/11/10 Project No. 171441-000050-000000

J:\CAD\171441\000050\Remedial Inv Report\
Plate-4.dwg Layout:FIGURE 10-2B March 15, 2010-10:15AM KHollenbeck



TRC

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SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 10-3A
DEEP GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - SMC SITE AND FARM PARCEL

Date: 06/20/11 | **Project No.** 177208-000050-000000

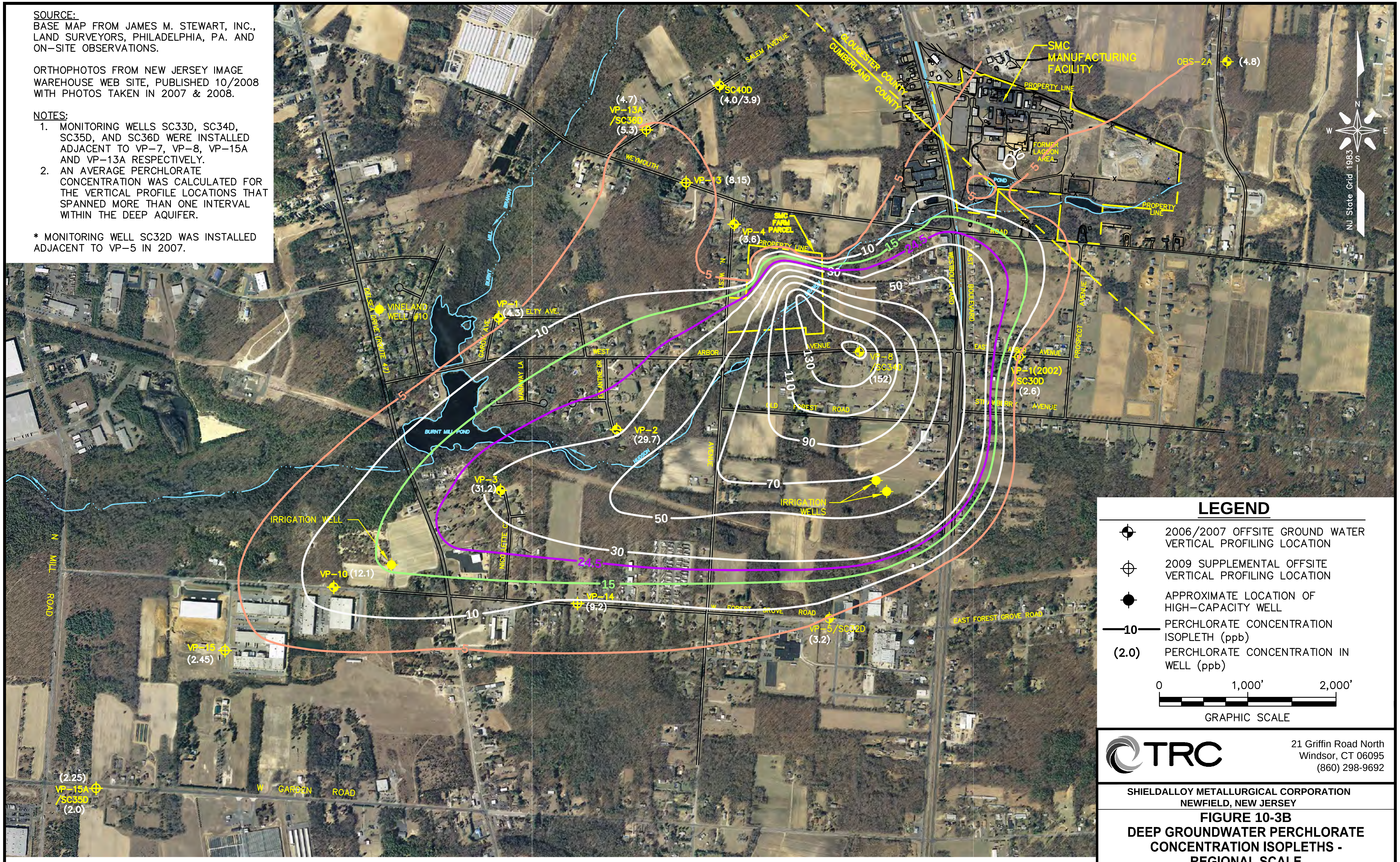
J:\CAD\177208\000050\
Plate-1.dwg Layout:FIGURE 10-3A June 21, 2011-3:16PM Raloma

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 10/2008 WITH PHOTOS TAKEN IN 2007 & 2008.

NOTES:
1. MONITORING WELLS SC33D, SC34D, SC35D, AND SC36D WERE INSTALLED ADJACENT TO VP-7, VP-8, VP-15A AND VP-13A RESPECTIVELY.
2. AN AVERAGE PERCHLORATE CONCENTRATION WAS CALCULATED FOR THE VERTICAL PROFILE LOCATIONS THAT SPANNED MORE THAN ONE INTERVAL WITHIN THE DEEP AQUIFER.

* MONITORING WELL SC32D WAS INSTALLED ADJACENT TO VP-5 IN 2007.



LEGEND

⌖	2006/2007 OFFSITE GROUND WATER VERTICAL PROFILING LOCATION
⌖	2009 SUPPLEMENTAL OFFSITE VERTICAL PROFILING LOCATION
●	APPROXIMATE LOCATION OF HIGH-CAPACITY WELL
—10—	PERCHLORATE CONCENTRATION ISOPLETH (ppb)
(2.0)	PERCHLORATE CONCENTRATION IN WELL (ppb)

0 1,000' 2,000'
GRAPHIC SCALE

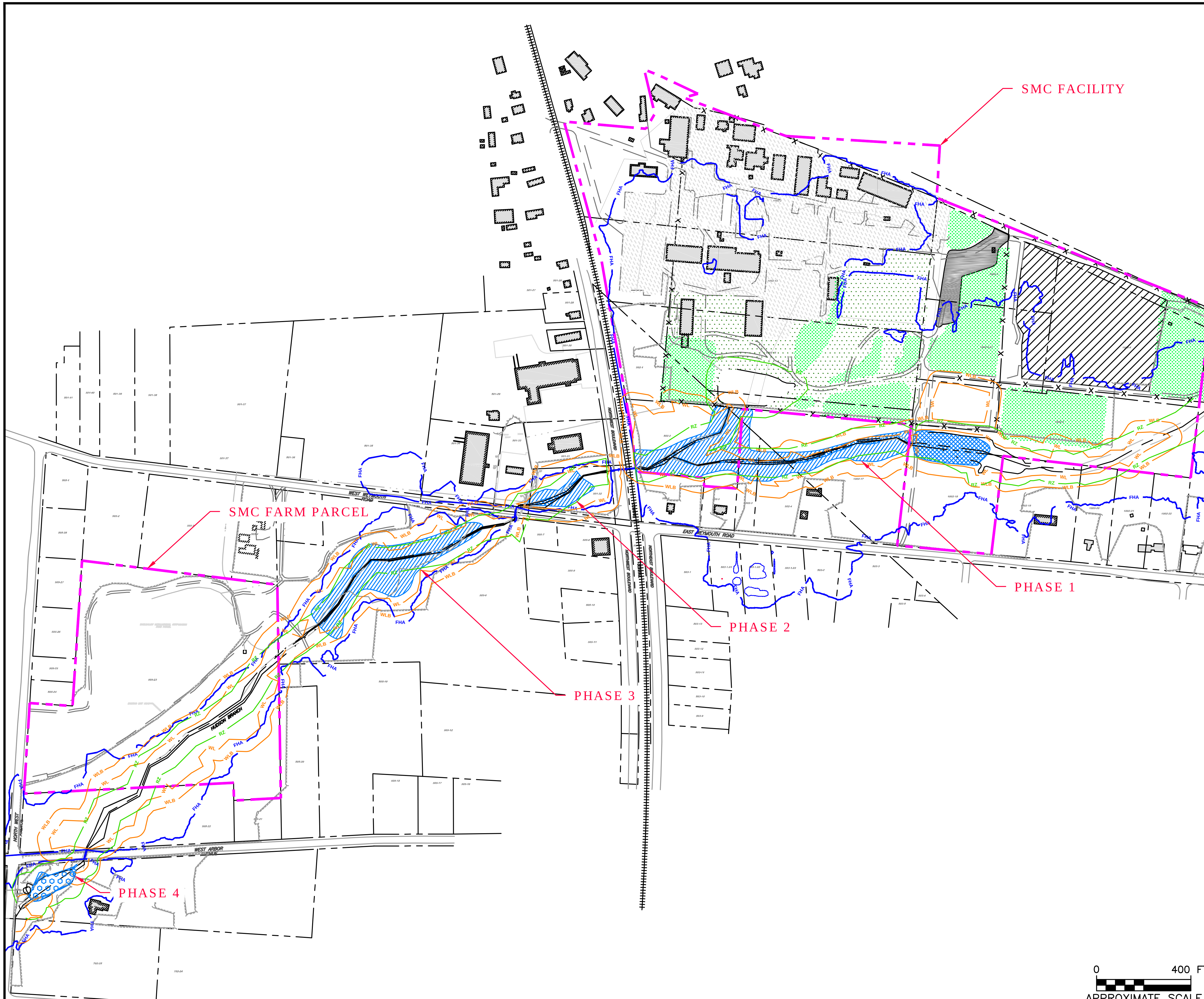
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 10-3B
DEEP GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - REGIONAL SCALE

Date: 06/20/11 | Project No. 177208-000050-000000

J:\CAD\177208\000050\
Plate-2.dwg Layout:FIGURE 10-3B June 21, 2011-3:18PM Raloma



LEGEND

- SITE BOUNDARY LINE
- TAX LOT LINE PER TAX MAP
- FIELD SURVEYED STREAM CENTERLINE
- EDGE OF WATER
- EXISTING TOP OF BANK
- EXISTING DIRT ROAD
- EXISTING FENCE LINE
- FHA — N.J.D.E.P. FLOOD HAZARD AREA LIMIT (DELINEATION BY TRC)
- RZ — N.J.D.E.P. 50 FT. RIPARIAN ZONE LIMIT
- WLB — WETLANDS BUFFER
- WL — WETLANDS LIMIT
- NATURAL RESOURCE RESTORATION PLANTING AREAS (NOTE: THESE AREAS WERE CAPPED UNDER REGULATORY LEGAL AGREEMENTS WITH 1–2' OF CLEAN SOIL AND VEGETATION, IN 1999 AND 2001.)
- PROPOSED 6" DEPTH EXCAVATION AND BACKFILL AREA (STREAM BANK AREA)
- PROPOSED 12" DEPTH EXCAVATION AND BACKFILL AREA (STREAM CHANNEL AREA)
- PROPOSED 24" DEPTH EXCAVATION AND BACKFILL AREA (STREAM CHANNEL AREA)
- PROPOSED ASPHALT CAP
- RESTRICTED AREA
- VEGETATIVE AREA INCLUDING GRASS, TREES AND DIRT ROADS
- FORMER PRODUCTION AREA WITH CONCRETE, ASPHALT, BUILDING SLAB, AND SOIL COVER.

TRC ENVIRONMENTAL CORP.
1601 Market Street, Suite 2555
Philadelphia, PA 19103

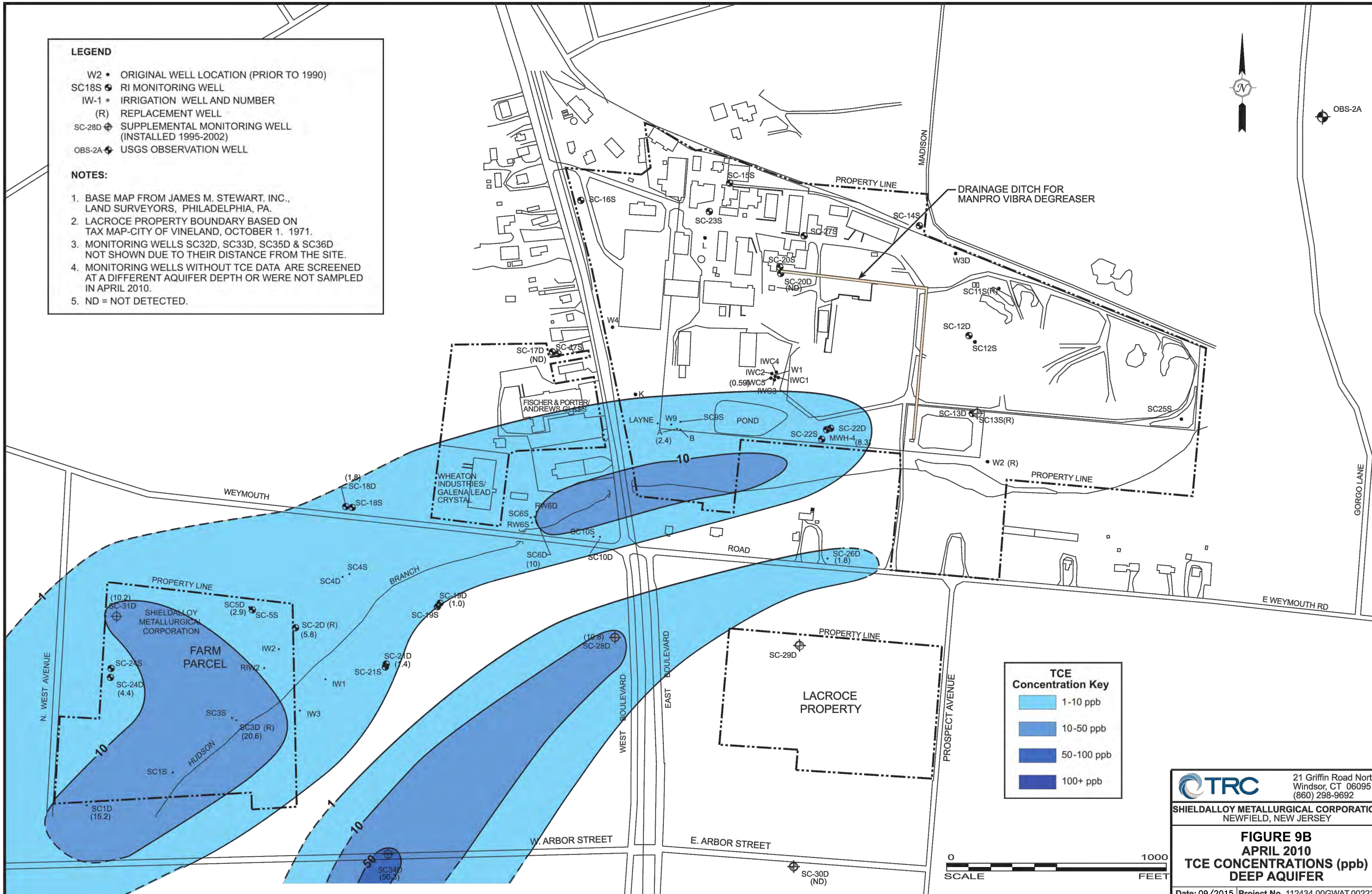
SITE PLAN

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, GLOUCESTER COUNTY, NEW JERSEY

JOB NO.: 112434

SJ/BJS/PJH | DATE: MARCH 2017 | FIGURE: 2

DRAWING NAME: W:\Raviv Project Folders\2501-3000\2710\Documents (WIP)\Reports (WIP)\2015 OU2\DWG\Figures\ 112434_Overall 11x17.dwg --- PLOT DATE: February 27, 2017 - 5:49PM --- LAYOUT: 11 X 17


LEGEND
W2 • ORIGINAL WELL LOCATION (PRIOR TO 1990)
SC18S RI MONITORING WELL
IW-1 • IRRIGATION WELL AND NUMBER
(R) REPLACEMENT WELL
SC-28D SUPPLEMENTAL MONITORING WELL (INSTALLED 1995-2002)
OBS-2A USGS OBSERVATION WELL
NOTES:
1. BASE MAP FROM JAMES M. STEWART. INC., LAND SURVEYORS, PHILADELPHIA, PA.
2. LACROCE PROPERTY BOUNDARY BASED ON TAX MAP-CITY OF VINELAND, OCTOBER 1. 1971.
3. MONITORING WELLS SC32D, SC33D, SC35D & SC36D NOT SHOWN DUE TO THEIR DISTANCE FROM THE SITE.
4. MONITORING WELLS WITHOUT TCE DATA ARE SCREENED AT A DIFFERENT AQUIFER DEPTH OR WERE NOT SAMPLED IN APRIL 2010.
5. ND = NOT DETECTED.
DRAINAGE DITCH FOR MANPRO VIBRA DEGREASER
PROPERTY LINE
MADISON
OBS-2A
SC-15S
SC-16S
SC-23S
SC-27S
SC-14S
W3D
SC-20S
SC-20D (ND)
SC11S(R)
SC-12D
SC12S
W4
SC-17D (ND)
SC-47S
IWC4
IWC2
W1
IWC1
(0.59) IWC5
IWC3
K
FISCHER & PORTER/ ANDREWS GLASS
LAYNE
W9
SC9S
POND
A (2.4)
B
SC-22D
SC-22S
MWH-4 (8.3)
SC-13D
SC13S(R)
SC25S
W2 (R)
PROPERTY LINE
10
(1.8) SC-18D
SC-18S
WEYMOUTH
WHEATON INDUSTRIES/ GALENA LEAD CRYSTAL
RW6D
SC6S
RW6S
SC10S
SC6D (10)
SC10D
ROAD
SC-26D (1.8)
GORGO LANE
E WEYMOUTH RD
SC4S
SC4D
BRANCH
PROPERTY LINE
(10.2) SC-31D
SHIELDALLOY METALLURGICAL CORPORATION
SC5D (2.9)
SC-5S
SC-2D (R) (5.8)
SC-19D (1.0)
SC-19S
1
FARM PARCEL
IW2
RW2
SC-24S
SC-24D (4.4)
SC-21D (1.4)
SC-21S
IW1
IW3
SC3S
SC3D (R) (20.6)
10
HUDSON
SC1S
SC1D (15.2)
N. WEST AVENUE
(10.8) SC-28D
PROPERTY LINE
SC-29D
WEST BOULEVARD
EAST BOULEVARD
LACROCE PROPERTY
PROSPECT AVENUE
1
10
50
SC34D (50.3)
W. ARBOR STREET
E. ARBOR STREET
SC-30D (ND)
TCE Concentration Key
1-10 ppb
10-50 ppb
50-100 ppb
100+ ppb
0 1000
SCALE FEET
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692
SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY
FIGURE 9B
APRIL 2010
TCE CONCENTRATIONS (ppb)
DEEP AQUIFER
Date: 09/2015
Project No. 112434.00GWAT.002236